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Designation	Weight kg.	Order No.	Codeword
3. Outfit and supplementary parts			
Adjustable holder for test tubes and small beakers up to $\varnothing = 28$ mm.	0.250	32 55 25	<i>Ubjif</i>
Special beaker $\varnothing = 26$ mm.	0.025	32 85 06	<i>Uboh</i>
1 C-cell with cover glass, 0.5 cm. stratum depth Ultrathermostat according to Höppler, normal model for 220 V. alternating current 48 to 52 cycles, including electrothermometer 0° to + 100° C., with electric connection and two connecting tubes	0.020	32 82 42	<i>Uiwgy</i>
Special filter L 2 h (for slight turbidities)	11.400	32 87 05	<i>Uhxka</i>
Fluorescence standard R in mount	0.003	32 52 70	<i>Ufnax</i>
Fluorescence standard O in mount	0.020	32 53 20	<i>Udzud</i>
Fluorescence standard BB in mount	0.020	32 53 21	<i>Ufrau</i>
Special filter L 420	0.020	32 53 24	<i>Uilwy</i>
LS-incandescent bulb 6 V 30 W for turbidity measurements	0.003	32 52 72	<i>Uihsy</i>
Mercury high pressure lamp HQE 40 for fluorescence measurements	0.020	2630 ZN 54	<i>Ukteb</i>
Miniature bulb 4 V 0.4 A for the reading and illuminating device	0.020	6540 ZN 54	<i>Uilik</i>
Electrothermometer 0° to + 100° C. with adjustment drum, for the Ultrathermostat	0.005	5040 ZN 54	<i>Uktxu</i>
Ocular attachment lens for strongly ametropic eyes, according to spectacle prescription	0.200	32 87 50	<i>Uhycr</i>
	0.010	32 55 98	<i>Udzve</i>

The apparatus is provided for connection with 220 V alternating current. Please request a separate quotation for other voltages and kind of current. The stated weights are not binding and only approximate.

Details of the illustrations are not binding for construction of the instruments. We gladly supply for use in scientific publications, electros of the illustrations, as well as reductions of the same, when available. The reproduction of illustrations or text without our consent is not permitted. Rights of translation are reserved.

OPTIK CARL ZEISS JENA VEB
Telegrams: Zeisswerk Jena

Phone 3541

Order List

Designation	Weight kg.	Order No.	Codeword
1. Basic outfit, consisting of:			
Photometer	2.600	32 51 90	<i>Uktol</i>
3 L-filters (L1, L2, L3)	0.010	32 52 12	<i>Ubkea</i>
2 attachment objectives f = 90 mm.	0.030	32 53 51	<i>Ucmdy</i>
Accessory for turbidity and fluorescence measurements with comparison glasses, four each for turbidity resp. fluorescence and a holder for normal 50 cc. beakers ϕ = 36 mm.	3.000	32 54 00	<i>Ulbap</i>
Holder for C-cells and fluorescence standard	0.250	32 55 31	<i>Ulbka</i>
Thermometer 0° to + 75° C., divisions 1° C., in protective sheath	0.030	32 87 66	<i>Ufnyo</i>
Reading and illuminating device for the graduated drums, with electric connection	0.350	32 56 10	<i>Uktda</i>
Transformer 30 VA 220/6 V ZN 5090.	3.500	—	<i>Ukthe</i>
Optical bench of triangular cross section 710 on stand	6.100	32 55 09	<i>Uktli</i>
Rider with column for the photometer	1.800	32 55 01	<i>Ubeps</i>
Rider with column for accessory	1.000	32 55 04	<i>Ubewy</i>
Basic outfit for 220 V alternating current	18.670	32 50 30	<i>Ulayo</i>
2. Outfits			
2.1 Outfit III b/4 for turbidity and fluorescence measurements, consisting of:			
Basic outfit as under 1	18.670	32 50 30	<i>Ulayo</i>
LS-incandescent bulb 6 V 30 W	0.020	2632N 54	<i>Ukteb</i>
Lamp mount with electric connection	0.370	32 56 31	<i>Uirax</i>
Turbid glass body in case	0.500	32 54 05	<i>Ubgoo</i>
Mercury high pressure lamp HQE 40	0.020	6540 ZN 54	<i>Uitlik</i>
Choking coil in housing for 220 V with lamp mount and electric connections	2.800	32 73 72	<i>Uilmo</i>
Fluorescence standard G in mount	0.020	32 53 22	<i>Ucpri</i>
Outfit III b/4 for 220 V alternating current	22.400	32 50 31	<i>Ukuok</i>

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Designation	Weight kg.	Order No.	Codeword
2.2 Outfit III b/3 for turbidity measurements only, consisting of:			
Basic outfit as under 1	18.670	32 50 30	<i>Ulayo</i>
LS-incandescent bulb 6 V 30 W	0.020	2632N 54	<i>Ukteb</i>
Lamp mount with electric connection	0.370	32 56 31	<i>Uirax</i>
Turbid glass body in case	0.500	32 54 05	<i>Ubgoo</i>
Outfit III b/3 for 220 V alternating current	19.560	32 50 32	<i>Ulxan</i>
2.3 Outfit III b/5 for fluorescence measurements only, consisting of:			
Basic outfit as under 1	18.670	32 50 30	<i>Ulayo</i>
Mercury high pressure lamp HQE 40	0.020	6540 ZN 54	<i>Uitlik</i>
Choking coil in housing for 220 V with lamp mount and electric connections	2.800	32 73 72	<i>Uilmo</i>
Fluorescence standard G in mount	0.020	32 53 22	<i>Ucpri</i>
Outfit III b/5 for 220 V alternating current	21.510	32 50 33	<i>Ulapz</i>
2.4 Supplementary outfit¹⁾ for turbidity and fluorescence measurements for a previously supplied Pulfrich Photometer, consisting of:			
Accessory for turbidity and fluorescence measurements	3.000	32 54 00	<i>Ulbap</i>
Rider with column for the accessory	1.000	32 55 04	<i>Ubewy</i>
2 attachment objectives f = 90 mm.	0.030	32 53 51	<i>Ucmdy</i>
3 L-filters (L1, L2, L3)	0.010	32 52 12	<i>Ubkea</i>
Turbid glass body in case	0.500	32 54 05	<i>Ubgoo</i>
Mercury high pressure lamp HQE 40	0.020	6540 ZN 54	<i>Uitlik</i>
Choking coil in housing for 220 V with lamp mount and electric connections	2.800	32 73 72	<i>Uilmo</i>
Fluorescence standard G in mount	0.020	32 53 22	<i>Ucpri</i>
Holder for C-cells and fluorescence standard	0.250	32 55 31	<i>Ulbka</i>
Thermometer 0° to + 75° C., divisions 1° C., in protective sheath	0.030	32 87 66	<i>Ufnyo</i>
Supplementary outfit for 220 V alternating current	7.660	32 50 44	<i>Uibex</i>

¹⁾ In ordering please state serial number of the photometer.

4. Description of the accessory apparatus for fluorescence measurements

For production of the fluorescence exciting UV light the incandescent bulb (3) is exchanged for a high pressure mercury lamp HQE. By inserting a UV filter in front of the lamp only radiation of less than 400 mμ is conducted into the water chamber. The fluorescent light excited in the sample, enters the left photometer opening, along the same path described in section 1. The two beams can be followed most readily in Fig. 1 which shows the accessory adjusted for fluorescence measurements.

The comparison brightness is produced thereby that a likewise filtered mercury light reaches one of the four comparison glasses (5), which it excites to fluorescence in a color characteristic of it.

Particular attention is to be paid to the tempering liquid in reference to its constancy during the measurement.

The same examination vessels are employed for fluorescence measurements as for turbidity measurements.

5. Working procedure in fluorescence measurements

If an examination vessel, filled e. g. with a solution containing vitamin B₁, is placed in the water chamber with aid of its holder, then a light wedge luminesces with blue color. Therefore the blue fluorescing comparison glass is to be inserted on the side of the comparison brightness. The observer now sees in the ocular one half of the field of view illuminated by the fluorescent light coming from the sample and the other half with that coming from the comparison glass. In the special case of determining vitamin B₁, color differences are equalised by inserting filter L 420. For fluorescences showing other colours one of the L-filters L1, L2, L3, supplied with the instrument is placed in the path of rays instead. Usually the fields still appear of different brightness. The two fields are set to equal brightness by turning the corresponding graduated drum. The reading on the black graduation of the drum directly indicates the relation of the fluorescence intensities in percents.

The concentration of the substance to be determined in general is directly proportional to the fluorescence intensity. It is expedient to take the concentration from a calibration curve which is made once for all with the aid of measurements on standard solutions of known concentration. On the other hand, in the substitution procedure, a solid fluorescence standard can be employed for concentration determinations in place of a sample solution of known concentration. For this purpose we supply four solid fluorescence standards designated as R, O, G, and BB, which fluoresce

red, orange, green, and blue. For porphyrin and vitamin B₁ determinations we are in a position to state the concentration value. For applying these standards in determining the concentration of other substances the standards must be calibrated by the user himself.

For characterising the fluorescence colour a measurement is made in succession with each of the three L-filters against a fluorescence comparison glass. In the case of all fluorescence phenomena, which embrace a relatively broad spectral region (oils, lacquers) the three obtained measuring values then represent a measure for the fluorescence colour and intensity of the sample in reference to the comparison glass.

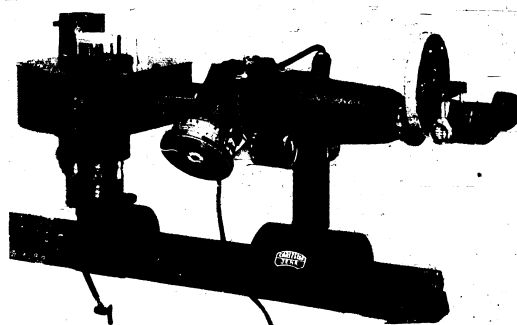


Fig. 3. Reading and illuminating device

In the examination of fluorescences of low intensity, which appropriately takes place in a darkened room, the graduated drums are illuminated by the reading and illuminating device which is clamped to the photometer housing with the aid of a holder, and the indications read without glare.

Detailed instructions are supplied with each instrument upon delivery.

Appropriate outfits are specified in the following order list, while prices and terms of delivery are given separately in the price list CZ 32-P525-1.

3. Advantages in use of the accessory for turbidity measurements

3.1 Absolute turbidity figures

With our instrument the turbidity of the sol to be investigated is referred to the unalterable and absolutely measured turbidity of a turbid glass body. Comparison sols, on the other hand, are reproduced with difficulty and change with time and temperature. Measuring values of a sol obtained at different times or with different instruments are only then directly comparable if they have been expressed in absolute values.

3.2 Serial examinations

Normal beakers or test tubes are employed as examination vessels. They can be conveniently filled and cleaned. It is particularly advantageous for serial examinations if the samples need not be transferred but can be measured in the vessel in which they were prepared.

3.3 Production of the turbidity during the observation

The vessels employed for examination in the Zeiss apparatus are easily accessible. Therefore stirring devices can be placed in the sols, or reagents allowed to flow in from burettes. In this manner turbidities can be measured at the time of formation.

3.4 Sensitivity

The apparatus permits the measurement of extraordinarily slight turbidities, not yet visible to the naked eye, as they are present e. g. in every potable water. In this case use is made of the lighter green filter L 2 h. The intense illumination required for this is attained by means of a lens system of large relative aperture.

3.5 Extended range of measurement without diluting the sols

Dilution of heavily clouded sols with the solvent, unavoidable in the past, can in many instances lead to an inadmissible change in the degree of dispersion. With the Zeiss apparatus the sols are measured undiluted. Instead of diluting, heavily clouded sols are examined in cells with a stratum depth reduced to 0.5 cm.

3.6 Tempering arrangement

With the aid of a tempering arrangement, e. g. the Ultra-Thermostat according to Höppler, the turbidity of sols can be measured at constant temperature. The temperature dependence of turbidities can be determined by raising the temperature of the tempering water during measurement. Turbidity reactions which take place only at higher temperatures, such as e. g. denaturation of albumin, can be directly brought about and followed chronologically.

3.7 Small amounts of liquid

If only a small amount of the liquid to be examined is available, test tubes are employed. Aside from requiring a small amount of liquid they have the further advantage of being inexpensive, easily handled, and available in various sizes. To be sure, glass of good quality should be selected.

3.8 Elimination of fluorescence

In fluorescent sols the fluorescent light, which would simulate a stronger turbidity, can be eliminated by inserting a red filter in the primary path of rays.



Fig. 2. Turbidity and fluorescence measurer on optical bench (about 1/4 nat. size)

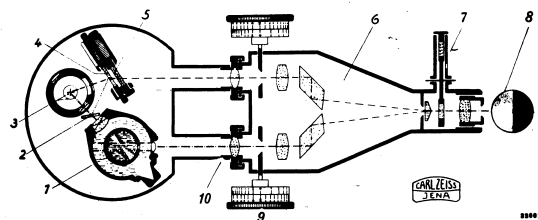


Fig. 1: Diagram of the Pulfrich Photometer for turbidity and fluorescence measurements

1 water chamber, 2 plane-parallel glass plate, 3 light source (incandescent bulb or HQE lamp), 4 comparison glasses for turbidity, 5 comparison glasses for fluorescence, 6 photometer, 7 filter disk, 8 field of view, 9 graduated drums, 10 attachment objectives

The Pulfrich Photometer for turbidity and fluorescence measurements consists of the accessory with light source (3) for production of the turbidity and fluorescence phenomena, and of the photometer (6) as measuring instrument. In the following sections the required apparatus and light sources are described and the working procedure presented according to whether turbidity or fluorescence measurements are to be carried out.

1. Description of the accessory apparatus for turbidity measurements

For turbidity measurements the accessory contains an incandescent bulb 6 V 30 W (3). The vessel containing the sol to be examined is placed in the water chamber (1). A part of the light from the electric bulb enters the chamber, through a lens system, in the form of a wedge-shaped beam. The light scattered by the sol at an angle of 45° to the direction of illumination arrives for measurement by way of a simple lens, in one of the openings of the photometer.

Another part of the light coming from the electric bulb is reflected by a plane-parallel glass plate (2), installed between the light source and the water chamber, and illuminates one of the four comparison glasses (4) having light dispersion of different intensities. The light scattered by these glasses arrives in the other opening of the photometer, and furnishes the comparison brightness required for measurement. The four comparison glasses can be brought selectively into the path of rays by turning a knurled metal disk.

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Attachment objectives $f = 90$ mm. (10) are mounted at the light entrance openings of the photometer, extending into the light shielding tubes of the accessory. Through these two attachment objectives the light scattered by the sample and that scattered by the comparison glass is brought to the two diaphragm openings of the photometer. The observer sees in the ocular a circular field of view (8) divided by a fine separation line. Each half of the field of view receives its light only from its respective photometer opening. By turning the corresponding calibrated drum (9) the brightness of each half of the photometer field of view can be varied. After the two halves of the field of view have been adjusted to equal brightness, the reading on one of the drums directly indicates the intensity of the scattered light of the sample relative to that of the comparison glass (4).

To avoid the appearance of disturbing fluorescence light with fluorescent sols, a red filter which absorbs the fluorescence-exciting rays from the primary light, can be inserted between the electric bulb and the plane-parallel glass plate. Since the turbidity of many sols depends upon the temperature, the water chamber is provided with a tempering bottom, through which a tempered flow of water is led. The constancy of the temperature is controlled with a thermometer.

The sols are examined in cylindrical beakers of 36 and 26 mm. diameter, in test tubes, or in plane cells, depending on the amount of sample and the intensity of the turbidity to be measured. The beakers require 25 resp. 10 cc. liquid, the plane cell of 0.5 cm. stratum depth about 1.8 cc.

2. Procedure in turbidity measurements

If a beaker filled with a sol (e. g. soap solution) is placed in the holder provided for it in the water chamber, then a liquid wedge of rectangular cross section lights up. Generally the two halves of the field of view in the ocular appear of different brightness and of different color. If now by turning the filter disk (7) of the photometer a filter, say a green filter, is brought into the path of rays, then both halves of the field of view appear green, the one half however brighter than the other. With aid of one of the graduated drums both halves of the field of view are brought to equal brightness. The reading on the drum then directly indicates the turbidity of the sol to that of the comparison glass. To determine the absolute turbidity the accompanying absolutely calibrated glass body is set into the place of the sample and the measurement repeated. The turbidity of the sol in absolute measure then is equal to the quotient of the two measured values, multiplied by the turbidity value of the turbid glass body. More detailed statements regarding the definition of absolute turbidity are found in an article by Sauer, H.: Beiträge zur Trübungsmessung. Z. techn. Physik 12 (1931) p. 148—162.

Measurements

of the turbidity and the fluorescence of liquids

in the past had to be carried out with totally different apparatuses supplementary to the Pulfrich Photometer. We now have so reconstructed the former turbidimeter that fluorescence measurements can also be undertaken with it. A rearrangement of the apparatuses is no longer necessary, but solely an exchange of light sources and turning of a filter carrier. With this innovation we hope to gain new adherents for these two important methods of turbidity and fluorescence measurement, and indeed, adherents beyond the circle of those who since many years have gathered valuable knowledge in most varied fields of science and technology and have transmitted it to the large circle of users of the Pulfrich Photometer. A suggested alternative for the preceding sentence: We hope this innovation will result in a much wider use, in most varied fields of science and technology, of these important methods of turbidity and fluorescence measurement.



Applications of the Pulfrich Photometer for measuring the turbidity and fluorescence of liquids

In

chemical, physical chemical and biological institutes
serological laboratories and forestry stations
clinical and pharmaceutical laboratories and institutes
water and foodstuff bureaus
breweries and wine cellars
industrial laboratories

for

nephelometric determinations and for following the chronological course and measurement of all turbidity reactions as e.g. of:

alkaloids (morphine, nicotine, quinine), albumin fractions in blood and liquor, calcium, chlorine, cholesterol, copper, ferments (amylase, cathepsin, pepsin, trypsin), fibrinogen, heparin, milk fat, phosphoric acid, potassium, sulfur, antitryptic titer, industrial and potable waters as well as liquids of various kinds (beer, wine, sugar solutions)

for

fluorimetric concentration determinations and fluorescence measurements, particularly of:

bile acids, chlorophyll, flavins, hydrastinine, oils, porphyrin, purine, pyrimidine, pyrimidine, quinine sulfate, sodium salicylate, urobilin, uropterin, vitamins B₁ and B₂, zinc oxide

determining turbidity and fluorescence of:

body fluids, solvents, tinctures, solutions of organic and inorganic salts and compounds (oils, resins, lacquers).



Specifications

Designation	Weight kg	Catalogue No.	Code- No.
Pocket Polarimeter incl. observation tube 95.04 mm., spare cover glass, illuminating mirror and stand, in wooden case	1.330	32 65 00	<i>Uhyty</i>
For replacement orders:			
Observation tube 95.04 mm.	0.020	32 65 79	<i>Uhywak</i>
2 - Cover glasses	0.002	32 65 80	<i>Uhyxt</i>
2 - Washers for observation tubes	0.001	32 65 81	<i>Ujtrmi</i>

Weights quoted are approximate and are given without obligation.

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VEB CARL ZEISS JENA

Opto-Physical Measuring Instruments Department

CZ 32-375a-2

V. V.10/13-2-A 300/54 DDR
Printed in Germany



Polarimetric examination of urine represents the simplest and most accurate method of quantitative determination of sugar in urine. The entire process requires but a few minutes time and can even be carried out during the consultation.

For the above purpose we designed the **Pocket Polarimeter**, which proved to be an indispensable device for the medical practitioner as well as for clinics. Easy to manipulate, it will even be possible for the patient himself to do his own checking.

The urine is filled into an observation tube, which, impervious to light, consists of acid-proof material, permitting easy cleaning. No special light protection of the tube being required, an **open** type of construction has been adopted, so that the instrument neither calls for closing up nor for dismantling. Readings may be taken at once, as soon as the tube has been inserted.

The rotation of the plane of vibration of the polarized light results in an angular value the magnitude of which represents a measure for the quantity of optically active substance contained in the solution.

As in urine-examinations the angles of rotation are invariably small, the employment of daylight or of an ordinary frosted incandescent lamp will be entirely adequate. No monochromatic light is required as the Pocket Polarimeter contains an accurately adjusted permanent light filter.

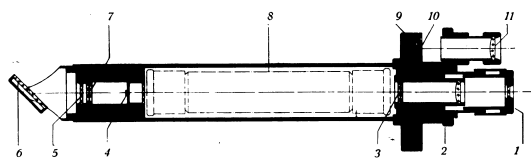


Fig. 1. Longitudinal Section through the Pocket Polarimeter

1 Eyepiece, 2 Focusing disc, 3 Analyser, 4 Laurent plate, 5 Orange filter, 6 Mirror, 7 Polarizer, 8 Observation tube, 9 Angular scale, 10 Vernier, 11 Reading magnifier

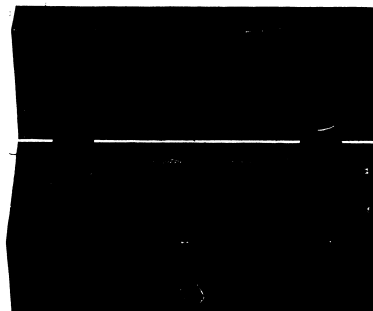


Fig. 2
Pocket Polarimeter
in its case

23014

The high light-transmitting capacity of its optical system permits of reliable measurements even of deeply coloured urine after the usual addition of a pinch of lead acetate and subsequent filtration. The large trisected visual field facilitates setting for equal brightness, permitting readings to an accuracy of $\pm 0.1^\circ$.

Cumbersome conversion of readings has been dispensed with by the adoption of an observation tube 95.04 mm. in length, thus merely requiring a multiplication of the ascertained angle of rotation by 2 in order to obtain the sugar percentage.

In the case of albuminous urine, two readings must be taken, viz., before and after removal of the albumen. The difference between the two readings indicates the albumen percentage.

Each instrument is supplied with a copy of working directions.

For the examination of medicaments and pharmacies, or for polarimetric measurements of cane or beet sugar, essential oils and foodstuffs, etc., in industrial laboratories, the **Zeiss Polarimeter with circular scale** is recommended as described in leaflet "Mess 32-580-2".

about the central axis of the instrument within the range of interpupillary distances. Therefore they can be adjusted to the interpupillary distance of every user. In so doing, the viewing direction always remains convergent for all interpupillary distances. The exit pupil of the inclined binocular tube is so computed that also spectacle wearers can see well without removing the spectacles (after taking off the eyecups). The eyecups (1) are slipped on the oculars (2) which have a shaft diameter of 34 mm.

The magnification is set by turning the dialling head (15). This is provided with arresting notches and also carries the indicator (14) for objective-telescope magnifications. A total magnification of 40 \times , e. g. with use of the ocular pair 25 \times , is obtained when the figure 1.6 of the indicator engages the catch at the index (18). A table (19) engraved on the right side of the pinion box, facilitates the rapid finding of the total magnification.

The "SM XX" is generally used with incident light. Usually the objects under investigation are sufficiently illuminated by daylight, this is favoured by the large free working distance. However, for more intensive illumination the instrument can be equipped with a lamp (6). This is attached to a guide bow (8) situated between the front objective (13) and the housing (5). The bow is detachable and can be swung about the optical axis of the instrument. The lamp, after loosening the clamping screw (7), can be adjusted between steep and grazing incidence of light. For transportation the lamp is removed from the guide bow and packed separately in the cabinet. It is easily slid on to the guide bow after depressing the blocking spring at its end.

A slip-on blue ground glass for the lamp provides for uniform illumination of the object and at the same time serves as a daylight filter.

The lamp is equipped with a clear spotlight bulb 6 V 15 W and is connected to the lighting system across a transformer.

Supplementary Devices

In addition to observation with incident light, the "SM XX" can also be used for the examination of objects in transmitted light. A suitable supplementary device for this purpose is the **base for transmitted light** (Fig. 3). The base is put into the free opening of the foot of the stand after removal of the insert plate. For illumination the lamp fitting with spotlight bulb is slid into the lateral opening of the base provided for the purpose. If a lamp for incident light is already on hand, its lamp fitting can also be used for the transilluminating base. If the "SM XX" is to be used simultaneously for incident and transmitted light we recommend the purchase of a second lamp fitting, including transformer. If so ordered, we supply a single transformer for simultaneous operation of both lamps.

For convenience in manipulation, e. g. in dissecting, the instrument can be equipped with rests for both hands (Fig. 3). The **handrest** consists of a bar which fits into a corresponding recess in the foot of the stand. On the right and left ends of the bar two wooden plates are mounted in ball cups. They can be fixed in any desired position by a clamping device operated by a laterally protruding pin.

Normally the plate inserted into the foot serves for holding the objects under investigation. For the examination of larger objects such as cloths, sheet metals, boards, etc., the stand can be placed directly on these objects, after taking out the insert plate (10) from the foot.

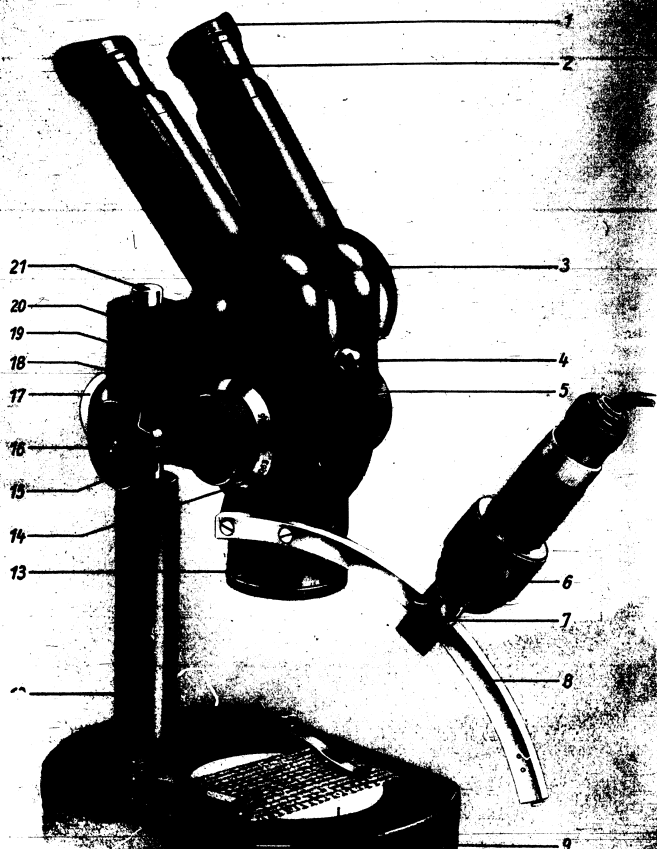


Fig. 6. Exterior of the microscope.

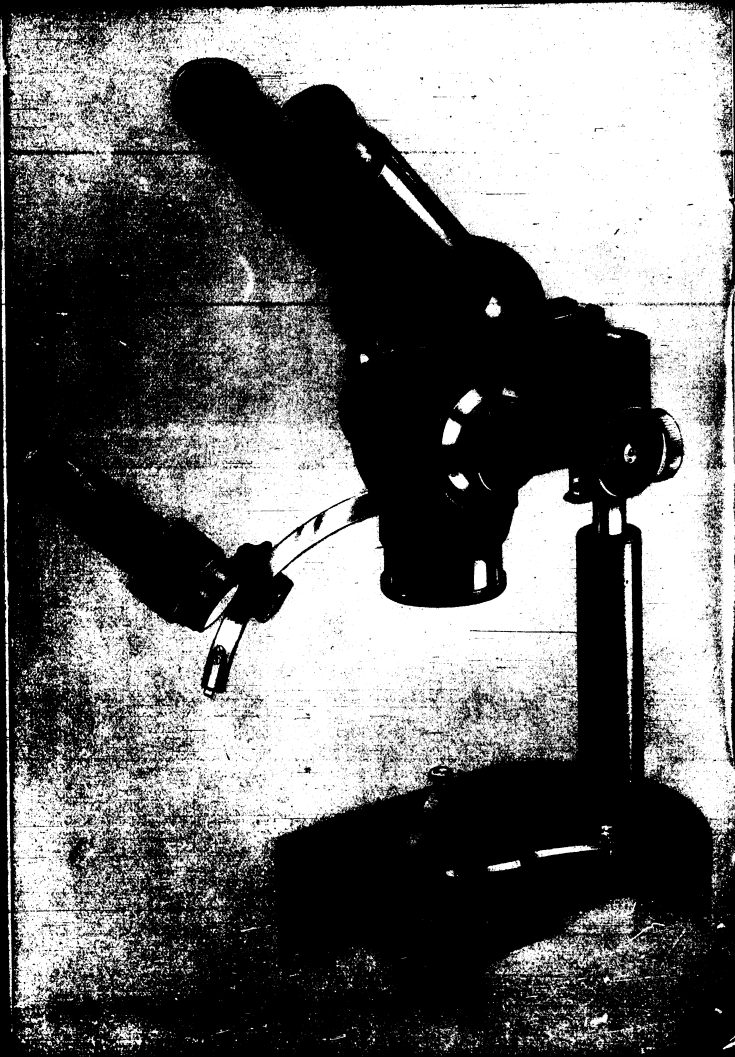
- | | |
|---------------------------|---|
| 1 eyecup | 12 stand pillar |
| 2 ocular | 13 front objective |
| 3 inclined binocular tube | 14 indicator for objective-telescope magnifications |
| 4 clamping screw | 15 dialling head |
| 5 housing | 16 pinion head |
| 6 lamp | 17 clamping screw |
| 7 clamping screw | 18 index |
| 8 guide bow | 19 table of total magnifications |
| 9 foot | 20 pinion box |
| 10 insert plate | 21 guide rod |
| 11 stage clip | |

Description and Directions for Operations

The stand pillar (12) with guide rod (21) is mounted on the foot (9). Two stage clips (11) and an interchangeable insert plate (10), one side enameled black the other white, complete the equipment of the foot.

The pinion box (20) can be displaced in height along the guide rod (21) and rotated about its axis. It is held by the clamping screw (17) which need be drawn up only lightly since a built-in band clamp provides sufficient hold for the pinion box. The rack and pinion focusing device is operated by the pinion head (16).

The inclined binocular tube (3) is mounted on the housing (5) in a rapid-changing device. After releasing the clamping screw (4) it can be removed and replaced in the reversed direction, i. e. rotated by 180° (see Figs. 5 and 6). The two ocular sockets of the inclined binocular tube can be rotated



another, likewise 0.63 and 4.0. Therefore the values cannot follow one another regularly rising or sinking. Instead the sequence is

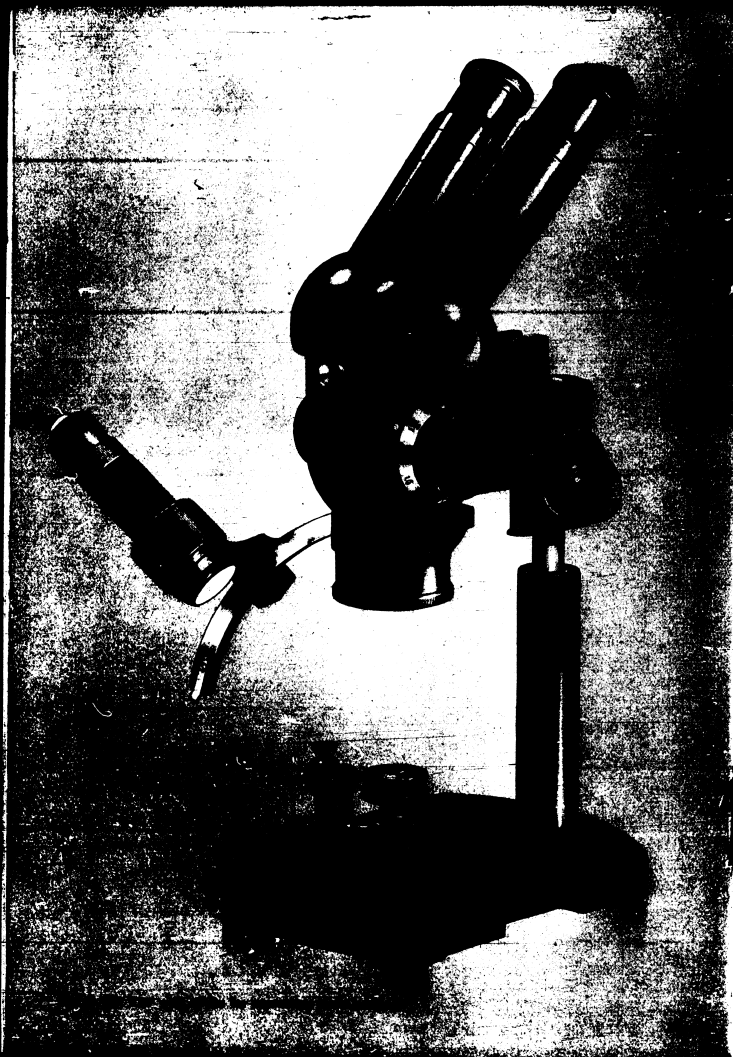
0.63 1.0 1.6 4.0 2.5 1.6

If it is desired to switch in progressively increasing magnifications, step 4.0 is skipped the first time.

The total magnifications and field of view diameters are presented in the following table:

Oculars	Value of objective-telescope magnification					Working distance about mm.
	0.63	1.0	1.6	2.5	4.0	
	Total magnification					
	Field of view diameters in mm.					
6.3 ×	4 ×	6.3 ×	10 ×	16 ×	25 ×	100
	44	28	17.5	11	7	
25 ×	16 ×	25 ×	40 ×	63 ×	100 ×	100
	12.5	8	5	3	2	

The sequence has intentionally been thus established in order to obtain with the low power ocular as far as possible the entire range coming into consideration for dissections, and because a finer gradation would be of no practical significance. Magnifications of 16 × and 25 × occur with both oculars.



extensive research was undertaken. On the basis of the data thus gathered, the construction was so arranged that very sensitive observers or those less versed in the art will be able to fuse the images without difficulty, and that prolonged use of the instrument produces no fatigue of the eyes.

The oculars (Kellner resp. Kerber type) are special systems of unusually good flatness of image and wide field of view. Their focal lengths are 40 mm. and 10 mm.

The optical data of the individual systems have been selected so that

1. a large, free working distance of 100 mm. is achieved and
2. the total magnifications constitute a geometric series, i. e. the series R 5 according to DIN 323 (German Industrial Standards) of 4.0 to 100

The magnifications resulting from objective and telescope components are marked at the individual catches on the dialling drum. These themselves are values of the normal series and, multiplied by the ocular magnification, yield the total magnification. The magnification number 1.6 on the dialling drum corresponds to the objective magnification itself (in viewing through the free aperture without interposed telescope). The less powerful one of the telescopes adds the factors 1.6 resp. 0.63 in reversed position, the stronger one 2.5 and 0.4, respectively. Thus there result for the dialling drum the values

0.63	1.0	1.6	2.5	4.0.
------	-----	-----	-----	------

Since two telescope systems and a free aperture cross, there are six positions of arrest. The value 1.6 for viewing through the free aperture occurs twice on the indication for the objective magnification. The values 1.0 and 2.5 belong to the same telescope system and therefore lie opposite one



The front objective has a focal length of 100 mm. and an effective aperture of about 40 mm. It consists of four lenses and structurally is comparable to modern photographic objectives. The aperture is about 0.08. Very special demands are made on the quality of this objective, for the image produced by it is required to stand up to a subsequent magnification of 40 \times . The objective is always used at full aperture.

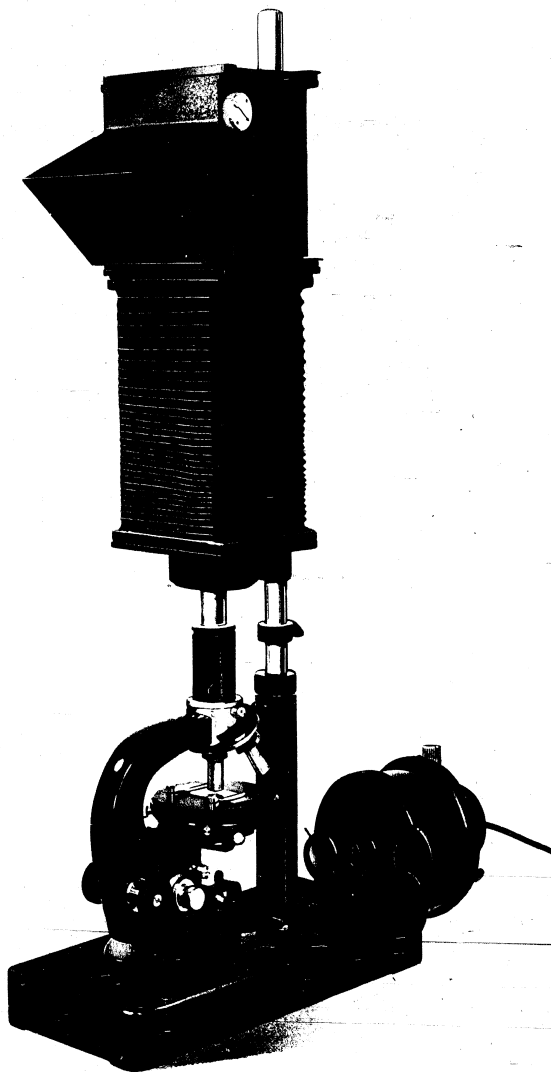
The reason for adopting the Galilean type was that the telescopes within the dialling drum had to be of short and compact built so as to make it possible to limit the dimensions of the drum.

These short-length telescopes being used both for magnification and reduction, particular refinement in correction was called for.

The tube lens has a focal length of 160 mm. and likewise enjoys an especially careful correction.

The prism element, a Schmidt type of tectiform prism, permits of adjusting the ocular sleeves for the observer's interpupillary distance. It further serves the purpose of erecting the image and of deflecting the optical path for inclined observation.

In adjusting the ocular sleeves for interpupillary distance there is a change in the angle of convergence of the ocular sleeves and a counter rotation of the two component images. Both phenomena may have an influence on the fusion of the two images during microscopy. Since relatively few references are found in this respect in the published literature of physiological optics,



Vertical Photomicrographic Camera

Simple and rapid operation, remarkable versatility and maximum performance in the various fields of photomicro and macrography are the salient features of this apparatus. One of the notable features is the fact that by altering the camera extension it will be possible to achieve different image-scales while using the same set of optics. The camera can be used in conjunction with any type of microscope suitable for photomicrographic purposes.

Vertical Photomicrographic Camera with illuminating arrangement consisting of:

base plate with column, extensible swing-out camera 9x12 cm., 2 metal plate holders, one frosted and clear glass screen each, light-protecting sleeve, lamp-housing and holder for 32 mm. Ø filter, shutter, light-tight connecting sleeve, focusing magnifier x6, protective filter (neutral glass) and reflector attachment (not including microscope nor electrical accessories)

Supplementaries:

Trichrome filter (1 yellow glass and 1 blue glass 32 mm. Ø)
Monocular straight tube connecting camera and microscope (required only for stereo "T"-microscopes)

For added cost:

Focusing magnifier, objectives with iris diaphragm for screw-on attachment to front panel of camera
Objective 1.8 NA, 13.5 cm. with coated elements, in special mount

Recommendations:

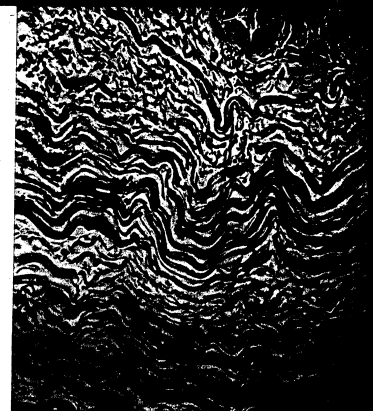
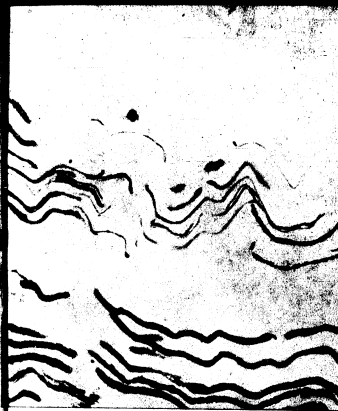
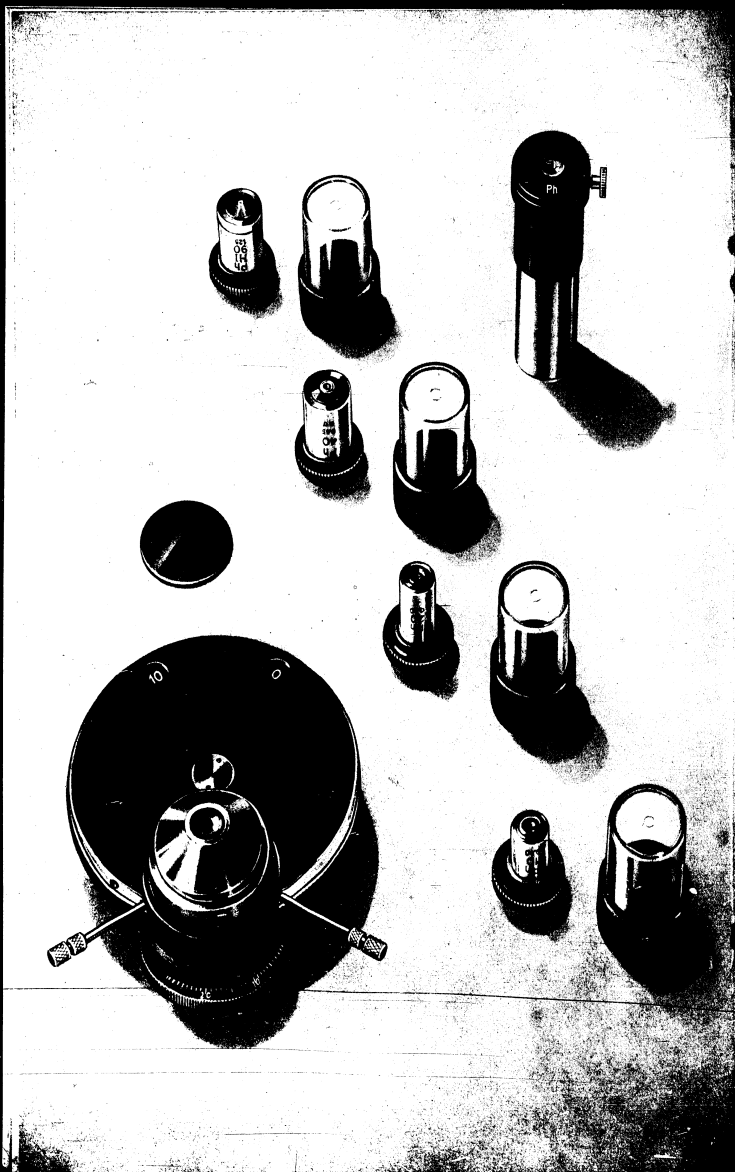
Multiplicator for determining the best exposure period (for 9x12 cm. size)

Electrical Accessories:

Projection lamp 12 V. 100 W. . . .
Low-voltage transformer 100 VA. 220/12 ZN 50/60

Catalogue No.	Codeword
30 60 60	Kwyo
30 46 45	Pjang
30 50 04	Kobac
30 86 40	Penaa
54 06 01	Kwohl
30 86 65	Kygor
25 44 ZN 54	Pekru Pekru

The illuminating arrangement operates from 200 V a. c. Please ask for special quotation if line-voltage and kind of current differ from the above.



300011

30/620

Longitudinal section of Human Peripheral Nerve (in connective tissue degeneration)
Left: bright field Right: phase contrast

New possibilities of observation in microscopy by means of the

Jena Phase Contrast Method

The phase contrast method is based all the way through on the Abbe Theory of microscopical depiction. It was derived mathematically from this theory by F. Zernike and borne out later on by actual experiment.

The first phase contrast equipment for practical work has been made and marketed by Jena Works.

The phase contrast method is of great importance to science in general and to biological and bacteriological research in particular in that it permits the observation of processes not demonstrable heretofore. This applies especially to unstained living microscopic objects which can now be observed and photographically recorded with a distinctness unobtainable in the past. The specific type of objectives designed for phase contrast work may be used also for the conventional microscope observation of stained specimens in bright and dark-ground illumination. The achromatic objective "Ph 90/125" homogeneous oil immersion is available for bright-field work only.

Components:

Achromatic Objective Ph 10/0.30
Achromatic Objective Ph 20/0.40
Achromatic Objective Ph 40/0.63
Achromatic Objective Ph 90/1.25 (homog. oil immersion)
Yellow/Green Filter
Phase condenser with auxiliary microscope

Catalogue No.	Codeword
30 20 83	Kusuk
30 20 80	Kusyo
30 20 81	Kutop
30 20 82	Kuteu
30 46 26	Pjapi
30 43 40	Kutoo

Phase Contrast Equipment¹⁾

as above 30 43 41 Kyhej

¹⁾ The phase contrast equipment is adaptable to any make of microscope provided the diameter of the condenser sliding sleeve is 39.5 mm. and that there is sufficient space for the revolving disc of the phase condenser (diameter 96 mm.).



Travelling Microscope "LrO"

This microscope is designed on the same lines as the other "Lg" models described herein. Departing merely in the shape of its foot and in being provided with a special type of stage the Travelling Microscope combines all the advantages of low-positioned coarse and fine-adjustments and inclined eyepiece, with low weight and small dimensions. Equipped with our standard supplementaries it represents at the same time an efficient laboratory type of microscope.

The Travelling Microscope is supplied in a convenient and well-sealed carrying case measuring 27.5x22x13 cm., weighing about 6 kos.

Recommendable Assembly:

Stand "Lr" with quick-change device for tube. Rack and pinion vertically adjustable substage O, fixed square object stage, including 10 specimen slides, 100 cover slips, 1 flask for immersion oil in metal capsule and 1 capsule of vaseline, in carrying case with lock and key 30 10 05 B
 Quadruple revolving nosepiece on dovetail slide 30 52 05
 Monocular inclined tube L 30 50 01
 Condenser 1.2 with iris diaphragm and colour glass holder 30 43 00
 Achromat 8/0.20 30 20 05
 Achromat 40/0.65 30 20 08
 Achromat 90/1.25 homogeneous oil immersion with iris diaphragm for dark-ground work (also for bright-field observation)
 Huygenian eyepiece X5 30 20 15
 Huygenian eyepiece X10 30 31 01
 Huygenian eyepiece X10 30 31 03

Monocular Travelling Microscope "LrO"

equipped as above
 for magnifications from X40 to X900 30 00 15

Optional Supplementaries:

Simplified attachable mechanical stage (75x25 mm. movement) ungraduated 30 51 10

Accommodation is provided for in the microscope case for the dissecting utensils, one mechanical stage and the Cornett forceps.

Catalogue No.	Codeword
30 10 05 B	Kymee
30 52 05	Kyhty
30 50 01	Knywa
30 43 00	Kymll
30 20 05	Kohok
30 20 08	Kohto
30 20 15	Kaitn
30 31 01	Komdu
30 31 03	Knurz
30 00 15	Kymgg
30 51 10	Kudyty

For further supplementaries please consult pages 20 and 21

in laboratories, to deter-
mined products, e. g. in
sh beet juice to the thick
sh to extend the refracto-
ls or the growing plant,

field use. We have there-
about two decades has

to 30 %
tent. As a rule the sugar
ance content.

30
tance.
e a photographic camera

ich takes place at once in

ar-cane plantations,

y in the growing plant,
er experiments,

**in viticulture, on vineyard estates, in grape-breeding
institutes, in teaching and research institutes for viti-
culture, in wine-pressing establishments, and in wine
and grape juice trade**

for determining the degree of maturity and therewith the time
of gathering,
for predictions concerning the excellence of the vintage,
for rapid determination of the must weight,
for variety selection,
for quality determination in the purchase of press grapes;

in fruit juice factories for quality control of fresh berries;

in marmelade and preserve factories for preliminary testing
of the pulp;

in short, wherever the dry substance content i. e. the total content of sugar
and non-sugar substances, is to be determined with rapidity and certainty
on numerous samples.

The advantages of the Hand Refractometer lie in
the simple manipulation of the instrument,
the rapidity of the measurement,
the small amount of material required for a measurement.

Basis of the measuring procedure is the empirical fact that a simple regular
relation exists between the dry substance content of sugar containing juices
and the amount of their light refraction. The measurement is made by ob-
serving the border line of total reflection. It is carried out with the Hand
Refractometer in reflected light.

In the examination of beets, a sample is removed with the beet corer (Fig. 1)
and a few drops of juice expressed by means of the hand juice press (Fig. 2).
In examining berries a simple squeezing of the fruit suffices.

A few drops of the juice (Fig. 3) are allowed to fall upon the prism face (3)
and then, after closing the cover (2), the instrument is held against the light.
If now one looks into the ocular (Fig. 4), the field of view (Fig. 5) appears
darker in the upper part than in the lower. The separation line is the border
line of the total reflection, which directly indicates the dry substance content
of the juice with an accuracy of $1/5\%$.

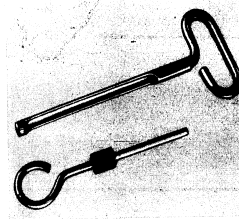


Fig. 1

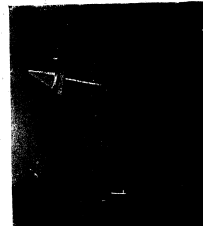


Fig. 4

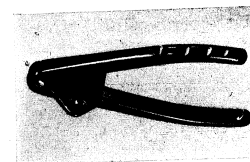


Fig. 2

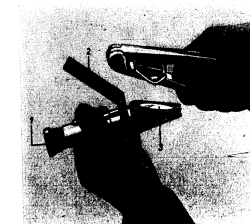


Fig. 3

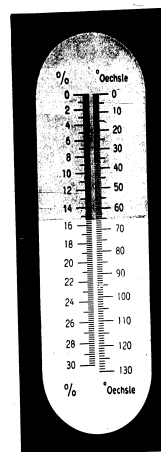


Fig. 5

Fig. 1. Beet corer with cleaning rod
Fig. 2. Hand juice press
Fig. 3. Applying the sample
Fig. 4. Measuring procedure
Fig. 5. Field of view

CARL ZEISS
JENA

Description	Weight	Key No.	Codeword
Accessories and Supplementaries			
Höppler Ultra Thermostat Model N for 220 V. a. c. 48 to 52 Per/S ¹⁾ including electro-thermometer 0° to + 100° C with lead and 2 lengths of rubber tubing	11.400	32 87 05	Uhxa
Electro-Thermometer 0° to + 100° C, with adjusting drum to the Ultra Thermo- stat	0.200	32 87 50	Uhyr
Electrical Pumping Aggregate for 220 V. a. c. 50 Per/S ¹⁾ with lead	1.650	32 76 33	Uhxp
Enamel vessel with felt-jacket (as a re- servoir)	2.200	32 87 17	Udnoj
one bottle monobrome-naphthalene . .	0.040	32 09 00	Ueddi
Thermometer 0° to + 50° C, 0.5° intervals, with sheath	0.050	32 87 58	Udyp
Wollny special thermometer (for butter and lard)	0.050	32 87 52	Udsdu
Baier special thermometer (for summer and winter butter)	0.050	32 87 53	Udsev

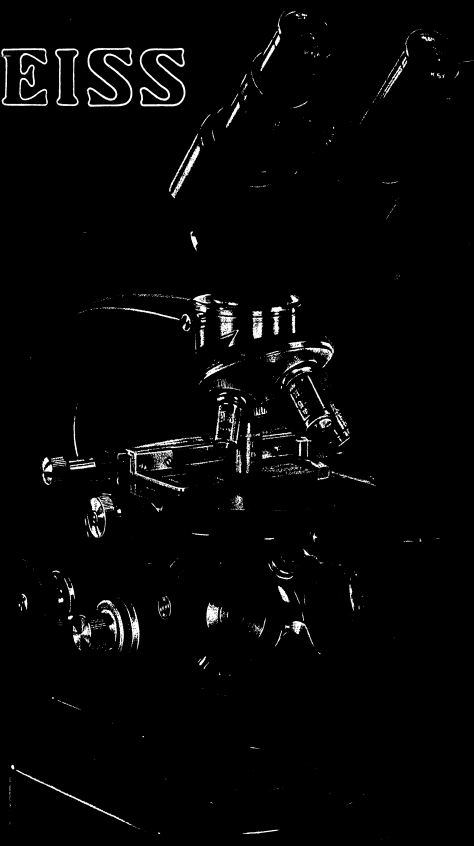
¹⁾ Please apply for special quotation if voltage and kind of current should differ from above.

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OPTIK CARL ZEISS JENA VEB

Telegrams: Zeisswerk Jena

ZEISS



LUMIPAN

Bibliography:

In the following an excerpt is given of publications dealing with the Refractometer for the Sugar and Oil Industry.

Modell I

Hugh Main, B. Sc., F. C. S.: Schnelle Wasserbestimmung in Zuckerprodukten wie Sirupen, Füllmassen etc. Z. Ver. Deutsch. Zucker-Ind. **57** (1907), H. 622, 1008—1015.

Schönrock, O., und Löwe, F.: Das Zucker-Refraktometer. Z. f. Instrkte. **33** (1913), S. 305.

Schönrock, O.: Theorie des Zucker-Refraktometers zur Ermittlung der scheinbaren Trockensubstanz in Zuckerstoffen. Z. Ver. Deutsch. Zucker-Ind. **71** (1921), H. 786, S. 417—440.

Landt, E.: Die Anwendung der refraktometrischen Methoden auf die Zuckeranalyse. Z. Die Deutsche Zuckerindustrie, Nr. 42 und 43 (1936).

Wucherer, H.: Praktische und gewissenhafte Marmeladenkocherei. Obst- u. Gemüse-Verwertg.-Ind. (1937), H. 12, S. 137; H. 15, S. 167; H. 16, S. 175.

Modell II (Formerly the Butter Refractometer)

Wollny, R.: Schlußbericht über die Butteruntersuchungsfrage. Milch-wirtschaftlicher Verein, Kiel, Korrespondenzblatt Nr. 39 (1891), S. 15.

Löwe, F.: Refraktometer im Fabriklaboratorium. Chemiker-Ztg. **45** (1921), S. 25—27 und S. 52—55.

N. N. Godbole and Sadgopal: Butter-Fat (Ghee), its nutritive value, adulteration, detection and estimation. Benares Hindu University, Benares (1930).

Löwe, F.: Optische Messungen des Chemikers und des Mediziners. Kap. III mit Tabellen und Schriftumverzeichnissen, 5. Auflage, Dresden, Th. Steinkopf (1950).

N. N. Godbole: The detection of adulteration of Butterfat (Ghee). (A suggested solution of an All-Indian Problem.) Current Sci. **4** (1936), S. 578—581.

Specification for Orders

Description	Weight	Key No.	Codeword
Assemblies			
1. For determining dry solids in Sugar-juices and jams and for purity tests of oils; consisting of:			
1.1 Model I with scales for dry solids and n_D values, incl. thermometer 0° to +50° C, calibration plate and one bottle of monobrom-naphthalene, in shipping case . .	7.500	32 02 50	Uctix
1.2 Model I (Tropical type) otherwise same as 1.1	7.500	32 02 51	Uclia
2. For dry solids determination and examination of edible fats; consisting of:			
2.1 Model II with dry solids scale and scale of the Butter Refractometer, incl. thermometer 0° to +50° C, calibration plate, one bottle of monobrom-naphthalene, and Wollny special thermometer, in shipping case.	7.550	32 02 56	Ulabb
2.2 Model II; with Höppler Ultra Thermostat for 220 V. a. c. 48 to 52 Per(S'), otherwise, same as 2.1	18.950	32 02 57	Ulaic

¹⁾ Please ask for special quotation if voltage and kind of current deviate from the above.

ded. The normal temperature adopted for butter and for oils 25° C.

When testing butter and lard a special thermometer is used, which, for pure samples, at once indicates limiting values. In the Wollny type of thermometer the limiting values represent the upper limits which experience has shown for butter. The right hand scale, headed by S, represents the upper limits for pure lard as shown per Wollny, Spaeth and Hefelmann.

As in the summer feeding period the refractometric limiting values for pure butter have been shown by Dr. E. Baier's¹⁾ investigations to differ from those in the winter feeding period, the Baier special type thermometer (cf. Fig. 4, right) shows the limiting values for summer butter, on the left-hand scale, headed S, and those for winter butter, headed W, on the right-hand scale, both in black, while for lard they are shown on the right-hand scale in red.

The following simple rule applies when using one of the two special thermometers for the investigation of butter or lard: The sample is to be considered suspect if the reading in the visual field is higher than that of the thermometer, whereas otherwise the sample is pure.

Temperature Regulating Equipment

Since the refractive index of liquids and fats is dependent upon their temperature, readings must be taken at uniform temperature to ensure a maximum of accuracy and comparable measuring result. To this end a water current is pumped through the prism mounts with one of the following aggregates.

¹⁾ Baier, E.: Erfahrungen über die refraktometrische Prüfung von Butter. Über ein neues Spezialthermometer. Z. f. Unters. d. Nahrungs- und Genußmittel, Berlin (1902), S. 1145.

For occasional measurements it will be sufficient to fill a vessel holding about 20 litres of water heated slightly above normal and to allow this slowly to flow through the prism mounts.

The electrical pumping aggregate together with the reservoir produces an uninterrupted current of temperature-regulated water. Its suction capacity amounts to about 1.5 litre per minute.

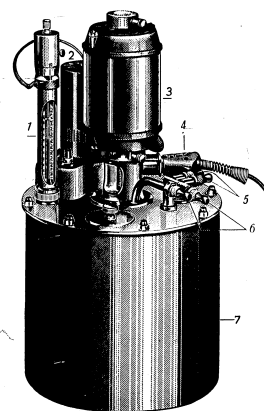


Fig. 5. Höppler Ultra Thermostat 20099

1 = Elect. thermometer. 2 = Relay. 3 = Motor and pump. 4 = Mains connection. 5 = Cooling water connections. 6 = Tube connection to Refractometer. 7 = Water reservoir.

When large series of continuous tests are to be made we recommend the use of the Höppler Ultra Thermostat (Fig. 6) which automatically produces a continuous current of temperature-regulated water fluctuating by no more than within $\pm 0.02^\circ \text{C}$.

Detailed working directions are being supplied with each Refractometer. Suitable assemblies are listed in the latter part of this pamphlet.

ded. The normal temperature adopted for all kinds of solid fats is 40° C and for oils 25° C.

When testing butter and lard a special type of thermometer may be used which, for pure samples, at once indicates the highest permissible limiting values. In the Wollny type of thermometer (cf. Fig. 4, left) the figures headed B represent the upper limits which experience has shown are valid for pure butter. The right hand scale, headed by S, in the same manner indicates the upper limits for pure lard as shown permissible by the investigations of Wollny, Spaeth and Hefelmann.

As in the summer feeding period the refractometric limiting values for pure butter have been shown by Dr. E. Baier's¹⁾ investigations to differ from those in the winter feeding period, the Baier special type thermometer (cf. Fig. 4, right) shows the limiting values for summer butter, on the left-hand scale, headed S, and those for winter butter, headed W, on the right-hand scale, both in black, while for lard they are shown on the right-hand scale in red.

The following simple rule applies when using one of the two special thermometers for the investigation of butter or lard: The sample is to be considered suspect if the reading in the visual field is higher than that of the thermometer, whereas otherwise the sample is pure.

Temperature Regulating Equipment

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¹⁾ Baier, E.: Erfahrungen über die refraktometrische Prüfung von Butter. Über ein neues Spezialthermometer. Z. f. Unters. d. Nahrungs- und Genußmittel, Berlin (1902), S. 1145.

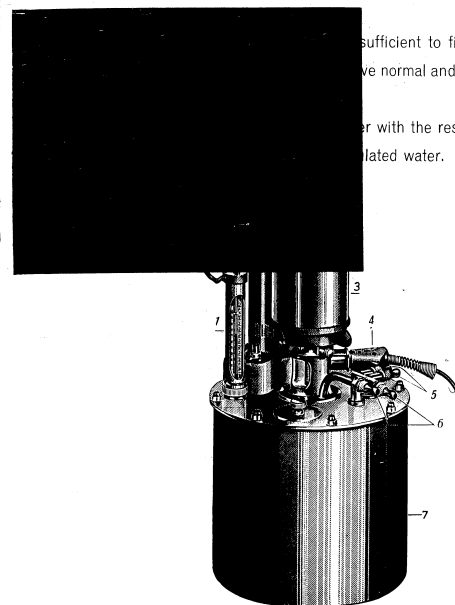


Fig. 5. Höppler Ultra Thermostat 24099

1 = Elect. thermometer. 2 = Relay. 3 = Motor and pump. 4 = Mains connection. 5 = Cooling water connections. 6 = Tube connection to Refractometer. 7 = Water reservoir.

When large series of continuous tests are to be made we recommend the use of the Höppler Ultra Thermostat (Fig. 6) which automatically produces a continuous current of temperature-regulated water fluctuating by no more than within $\pm 0.02^\circ \text{C}$.

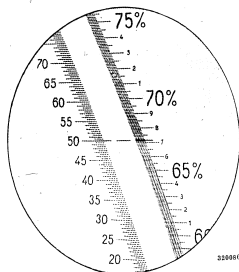
Detailed working directions are being supplied with each Refractometer. Suitable assemblies are listed in the latter part of this pamphlet.

The permissible variation amounts to $\pm 0.1\%$ to $\pm 2\%$ dry solids, whereas the n_D -values read to an accuracy of one to two units of the fourth decimal.

Model I is supplied either as the

Standard Equipment: for 20° C normal temperature for the temperate zone, with a scale of 0—95% dry solids content, or

Tropical Equipment: for 28° C normal temperature with a scale of 0 to 85% dry solids content.



Model II

Running parallel to the dry solids scale a second scale is provided in this model identical with the classical scale of the former Butter Refractometer, but proceeds at either end with refractive index scales, viz., $n_D = 1.42$ to $n_D = 1.30$ and $n_D = 1.49$ to $n_D = 1.54$. Thus the instrument is at the same time available also as a Butter Refractometer with its former measuring range extending from $n_D 1.42$ to $n_D 1.49$, permitting readings to be taken of butter, margarine, lard, beef-tallow, coconut and cocoa butter as well as

of other edible fats, also of cheese and all edible oils. Upon request we supply conversion tables for converting butter scale values or dry solids percentages into refractive indices. Thus, Model II will be useful to:

**Food Control Laboratories,
Customs Authorities,
Foodstuff Industries,
Dairy Laboratories as well as in
oil mills and other industries.**

By incorporating different scales the applicability of Model II has been considerably extended in scope over that of the former Butter Refractometer, so that in some cases Model II will replace two models of refractometers.

For instance, when for the purpose of examining pure butter the critical line has been achromatised with the aid of the compensator, and the respective position of the compensator maintained for all further butter tests, it will be possible to at once detect adulterations in the butter as revealed by the colour fringe of the critical line showing up more or less prominently.

For controlling the temperature of the measuring and illuminating prism the temperature control equipments described on pages 8 and 9 have been provided.



Fig. 4. Special thermometer

Model I

is used both for determining the dry solids percent in beet and sugar juices, jams, honey etc., and for testing the degree of purity of a great variety of fats and oils as well as of aqueous, alcoholic and ethereal solutions. The instrument is specially well adapted for routine examinations and for this reason preferred by industrial laboratories, chemical institutes, food control laboratories etc.

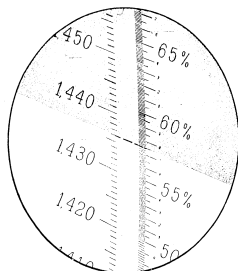
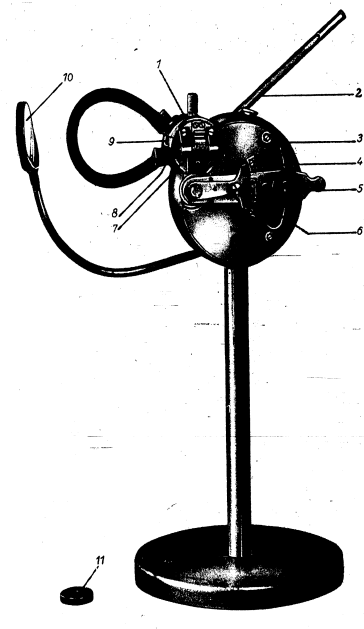


Fig. 1. Visual field of Model I showing the line index mark and the scales for refractive indices and dry solids percent. The index mark is set to coincide with the critical line.

Measuring Method

On the sample having been placed between the two prisms, the light should be made to enter one of the openings 8 or 9 shown in Fig. 2, whereupon the field of view will be seen divided into bright and dark halves. The line separating the two halves represents the critical line of total reflection and in the majority of cases shows a colour fringe which may be eliminated with the aid of the compensator (6).



- 1 and 7 Illuminating and Measuring Prism in heatable mounts
- 2 Thermometer
- 3 Housing
- 4 Scales
- 5 Eyepiece
- 6 Lever for setting the compensator
- 8 Opening for reflected light
- 9 Opening for transmitted light
- 10 Illuminating Mirror
- 11 Ocular stop

Fig. 2. Refractometer for the Sugar and Oil Industry

By swinging the arm which carries the eyepiece with the broken index line, the latter is brought to coincidence with the critical line. The left part of the index line cuts into the refractive index scale (n_D scale = 1.300 to n_D 1.540 while the right hand end protrudes into the dry solids scale, as shown in Fig. 1.

Ease of Manipulation
Economical use of Testing Substance
Remarkable Reading Accuracy
Rapidity in Measuring

are responsible for the successful adoption of the Zeiss Refractometer wherever liquids including juices, solutions, oils and fats must be characterised in terms of refractive indices or dry solids content. Readings of the latter are taken in an eyepiece and merely require the adjustment of an index mark to coincide with the critical line of total reflection.

The scale values in terms of dry solids correspond with those of the "International Scale 1936" as proposed by E. Landt¹⁾ and adopted by the International Commission for Uniform Methods of Sugar Analysis (London 1936). The respective part of the resolution reads as follows:

"The following values have been resolved to represent the 'International Scale 1936' for refractive indices n_D of sugar solutions at 20° C, viz., up to 24% the values of Schönrock-Landt (1933) from 24% to 66% values of Schönrock-Landt (1911), and from 70% to 85% those of Main (1906)."

¹⁾ cf. reprint "Ms 789" which will be gladly sent on request

The Refractometer for the Sugar and Oil Industry indicates the exact percentage of dry solids in pure sugar solutions. In those instances where the substance under investigation contains other solved substances besides the sugar solution, the value given by the refractometer (referred to as "water soluble extract") usually approaches very closely to the percentage of dry solids, as the solved non-sugar substances react upon refraction almost in the same way as sugar solutions.

The reading of the refractometer does not however embrace the undissolved ingredients as of jam, for instance. For "insolubles" an average of 2% is to be added to the dry solids amount indicated by the refractometer. As this amount does not apply to all kinds of fruit and is likely to differ from one campaign to another, the difference between refractometer reading and the actual dry solids content should be definitely ascertained by weighing it in one instance and the result accordingly taken into account for future readings. By following this procedure a maximum of accuracy will be achieved in the refractometric method of measuring jams.

The versatile application of the Sugar and Oil Refractometer, — especially for investigating food-stuffs — and the fact that the manufacture of the Zeiss Butter Refractometer has been discontinued, have prompted us to turn out two models of the Refractometer for the Sugar and Oil Industry, viz., Model I and Model II. They merely differ in the graduation of their scales as seen in the field of the eyepiece, so that Model II may also be used in place of the former Zeiss Butter Refractometer.

¹⁾ As advised by Prof. Träufel, of the Institut für Ernährung und Verpflegungswissenschaft, Potsdam-Rehbrücke.

ZEISS

FERTIGUNGSPROGRAMM

Mikroskope
Mikrophotographische Geräte
Mikroprojektionsgerät
lumineszenzeinrichtung
Zusatzgeräte für Mikroskopie

Kolposkope
Operationsmikroskop
Ohrspiegel
Beleuchtungseinrichtungen für Operationssäle
Mundleuchte

Geräte zur Untersuchung der Augen
Geräte zur Bestimmung und Prüfung von Brillen
Lupen

Refraktometer
Laboratoriums-Interferometer
Handspektroskope
Spiegelmonodromator
UV-Spektrograph Q 24
Lichtelektrische Photometer
Pulfrich-Photometer
Polarimeter
Konimeter
Abbe-Komparator
Skalengalvanometer

Mechanische Geräte für Längen-
und Gewindemessungen
Zahnradprüfgeräte
Optisch-mechanische Geräte für Längen-,
Gewinde- und Profilmessungen
Geräte für Winkel-, Teilungs-
und Fluchtungsprüfungen
Profilprojektoren
Interferenzkomparator
Endmaße

Nivelliere
Theodolite

Reduktions-Tachymeter
Zusatzgeräte
Photographische Objektive
Kino-Aufnahme- und Projektions-Objektive
Reproduktions-Optik
Prismenvorsätze für Stereoaufnahmen

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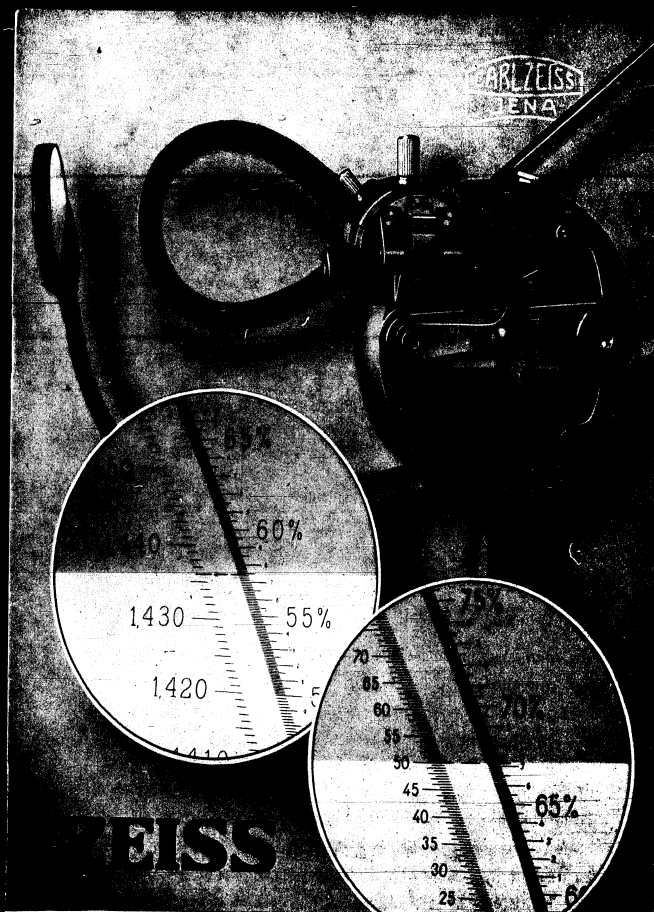
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Benennung

Gewicht kg Bestellnummer Bestellwort

1. Grundausrüstungen

1.1 für Messungen von Gasen:

- Laboratoriums-Interferometer einschl. zwei Auflagen mit Säule und Rundfuß, ohne Kammern 28,000 32 10 31 *Ucuky*
 Vierwegehahn 0,060 32 12 42 *Ucvly*
 Kleinspannungs-Transformator 2,2 VA 220/6 ZN 5090 mit Anschlußleitungen 1,500 — *Uldlz*
 2 Zwerglampen F 6 V 1,8 W (als Ersatz) 0,010 5433 ZN 54 *Uldma*
 Spezial-Transportkiste zum Laboratoriums-Interferometer 28,000 32 91 00 *Ucvse*

Grundausrüstung LG ohne Kammern . . . 57,570

Benennung

Gewicht kg Bestellnummer Bestellwort

1.2 für Messungen von Gasen und Flüssigkeiten:

- Grundausrüstung LG wie unter 1.1 . . . 57,570
 Temperiertrog mit Rührer 2,000 32 12 49 *Uldnb*
 Thermometer 0° bis + 50° C, Teilungswert 0,1°, mit Eichschein 0,080 32 87 62 *Udabj*
 Behälter für 4 Flüssigkeitskammern . . . 0,900 32 91 03 *Udago*
 Grundausrüstung LGF ohne Kammern . . . 60,550

2. Kammern je nach Bedarf

2.1 zweiteilige Gaskammern aus Glas

- 100 cm lang 1,850 32 12 10 *Ucuyt*
 50 cm lang 1,200 32 12 11 *Ucvam*
 25 cm lang 1,100 32 12 12 *Ujepa*
 10 cm lang 1,000 32 12 13 *Ucver*
 Behälter für die Kammer 100 cm . . . 6,000 32 91 16 *Uciji*
 Behälter für die Kammer 50 cm . . . 4,000 32 91 17 *Uciji*
 Behälter für die Kammer 25 cm . . . 2,000 32 91 18 *Ukyld*
 Behälter für die Kammer 10 cm . . . 0,800 32 91 19 *Ukyme*

2.2 dreiteilige Glas-Gaskammer 100 cm, für Stoffwechselbestimmungen . . . auf Anfrage

2.3 Flüssigkeitskammern aus Glas

- 80 mm Schichtdicke 0,300 32 13 60 *Uczlu*
 40 mm Schichtdicke 0,280 32 13 61 *Uczox*
 20 mm Schichtdicke 0,280 32 13 62 *Uczpy*
 10 mm Schichtdicke 0,280 32 13 63 *Uczsa*
 5 mm Schichtdicke 0,280 32 13 64 *Uczuc*
 Behälter für 4 Flüssigkeitskammern . . . 0,900 32 91 03 *Udago*

2.4 Flüssigkeitskammer aus Metall

- 10 mm Schichtdicke, mit Einsatz für 1 mm Schichtdicke 0,480 32 13 45 *Uczai*

Die angegebenen Gewichte sind nur annähernd und unverbindlich.

Die Zusammenstellung einer in jeder Hinsicht zweckmäßigen Ausrüstung bitten wir daher nur auf Grund der Erläuterungen zur Bestimmung der Kammerlänge (S. 9 bis 11) in Verbindung mit der Bestelliste oder nach Beratung durch uns vorzunehmen.

Jedem Interferometer wird eine Absolut-Eichtabelle beigegeben, die eine Umwertung der gemessenen Trommelwerte in die entsprechenden Streifen-zahlen h (s. Grundformel S. 10, oben) in dem allgemein nur bis etwa 600 Einheiten der Meßtrommel benutzten Bereich gestattet. Die Eichung mit monochromatischem Licht (vgl. Anm. S. 9) kann vom Benutzer jederzeit auf einen größeren Bereich ausgedehnt werden. Auf besonderen Wunsch, der uns schon bei der Bestellung mitgeteilt werden mußte, sind wir gern bereit, die Eichung bis zum äußersten Meßbereich von 3000 Einheiten durchzuführen. Die Vielfalt der zu untersuchenden Objekte erlaubt keine einheitliche Eichung aller Interferometer für bestimmte Substanzen. Bei den meisten interferometrisch zu untersuchenden Substanzen kommt es darauf an, die prozentuale Zusammensetzung eines Gemisches oder den Prozentgehalt einer Lösung festzustellen. Um zu diesen Werten ohne die oft schwierige empirische Eichung zu kommen, läßt sich, soweit für die Brechungsindizes der betreffenden Substanzen Werte im Schrifttum bereits vorliegen, eine Tabelle errechnen, die aus der auf Normalbedingungen reduzierten Streifenzahl h den Prozentgehalt angibt. Die Tabellen werden von uns auf Wunsch bei Angabe der Gerätenummer und der genauen Kammerlänge gegen Erstattung der Selbstkosten angefertigt.

Tragbare Interferometer

Die tragbaren, früher von uns gefertigten Interferometermodelle für die Untersuchung von Flüssigkeiten und Gasen sowie das Grubengas-Interferometer sind noch nicht wieder lieferbar. Neukonstruktionen sind in Vorbereitung.

Schrifttumverzeichnis

Den vielseitigen Anwendungen des Interferometers in Wissenschaft und Technik entspricht ein sehr umfangreiches Schrifttum, das wir im Rahmen dieser Druckschrift nur im Auszug wiedergeben können.

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haben, wenn man noch $p_{\min} \%$ eines Stoffes nachweisen will, bzw. wenn der absolute Fehler der Konzentrationsmessung höchstens $p_{\min} \%$ ausmachen soll. (Hierbei ist zur Vereinfachung $100 \cdot 5,5 \cdot 10^{-4}$ durch $2 \cdot 10^{-3}$ ersetzt.)

Den hier angeführten Formeln liegt die Beziehung zugrunde:

$$I = \frac{100 \cdot h \cdot \lambda}{p (n_2 - n_1)}$$

Darin bedeutet h die Anzahl der Interferenzstreifen, die beim Füllen der Kammern im Okular vorbeiwandern.

Beispiel:

Antwort zu a: Es soll ein Luft- CO_2 -Gemisch untersucht werden.

Antwort zu b: Die Brechungsindizes sind
für Luft (ohne CO_2): $n_1 - 1 = 292 \cdot 10^{-6}$
für CO_2 : $n_2 - 1 = 450 \cdot 10^{-6}$

Antwort zu c: Das Gasgemisch kann bis zu 20% CO_2 enthalten.
Dann darf die Kammerlänge höchstens

$$l_{\max} = \frac{5,5}{20 \cdot 158 \cdot 10^{-6}} = 1,7 \cdot 10^3 \text{ mm} = 170 \text{ cm sein;}$$

man kann also die längste, die 100-cm-Kammer, nehmen.

Antwort zu d: Es sollen noch 0,03% CO_2 nachgewiesen werden.
Dann muß die Mindestlänge der Kammer

$$l_{\min} = \frac{2 \cdot 10^{-3}}{0,03 \cdot 158 \cdot 10^{-6}} = \frac{2 \cdot 10^3}{4,74} = 422 \text{ mm} = 42,2 \text{ cm sein;}$$

man kommt also schon mit der 50-cm-Kammer aus.

Bei einem Höchstgehalt von 20% CO_2 könnte man mit der 100-cm-Kammer noch 0,014% CO_2 in reiner Luft erkennen. Diese Nachweisempfindlichkeit ist für jede Kammerlänge und für jeden Stoff verschieden. Sie beträgt z. B. bei der Messung von CH_4 oder H_2 gegen Luft mit der 100-cm-Kammer etwa 0,015%, mit der 50-cm-Kammer 0,03% und mit den 25- und 10-cm-Kammern etwa 0,06 bzw. 0,15%.

Die Abhängigkeit der Meßgenauigkeit (Fehlergrenze) und des Meßbereichs von der Kammerlänge geht auch aus nachstehender Übersicht hervor.

Kammerlänge bzw. Schichtdicke	Fehlergrenze für $n_2 - n_1$	Äußerster Meßbereich
100 cm	$2 \cdot 10^{-8}$	0,00005
50 cm	$4 \cdot 10^{-8}$	0,00010
25 cm	$8 \cdot 10^{-8}$	0,00020
10 cm	$2 \cdot 10^{-7}$	0,00050
80 mm	$2,5 \cdot 10^{-7}$	0,00063
40 mm	$5 \cdot 10^{-7}$	0,00125*
20 mm	$1 \cdot 10^{-6}$	0,00250*
10 mm	$2 \cdot 10^{-6}$	0,00500*
1 mm	$2 \cdot 10^{-5}$	0,05000*
Eintauchrefraktometer mit Meßprisma I	$2 \cdot 10^{-5}$	0,04000

In der zweiten Spalte der Tabelle ist die Fehlergrenze angegeben, die bei der Messung des Brechungsunterschiedes $n_2 - n_1$ zwischen rechter und linker Kammerfüllung auftreten kann. Dieser Wert entspricht etwa einer Einheit der Meßtrommel oder rund $1/30$ Streifenbreite in dem zur Eichung benutzten grünen Licht.

Die dritte Spalte enthält die maximalen Brechungsunterschiede $n_2 - n_1$, die von dem Gesamtbereich der Meßtrommel = 3000 Einheiten erfaßt werden können. Die mit * bezeichneten Flüssigkeitskammern sind in dem jeweils angeführten Meßbereich nur dann gegeneinander auswechselbar, wenn das benutzte Interferometer mit jeder Kammer nach den Regeln der Gebrauchsanweisung CZ 32-G205-1, Abschnitt 8, geeicht wird. Ohne diese Eichung sind die Kammern nur in einem Meßbereich bis zu 0,0100 austauschbar. Die auf S. 8 der vorliegenden Druckschrift mit aufgeführte Flüssigkeitskammer von 5 mm Schichtdicke kann bei einer Fehlergrenze von $4 \cdot 10^{-6}$ nur nach Eichung in einem Meßbereich von 0,0100 benutzt werden.

Das Verfahren zur Wahl der Kammerlänge bzw. der Schichtdicke ist für Flüssigkeitskammern grundsätzlich das gleiche wie für Gaskammern, gemäß vorstehender Beschreibung. Falls die Werte der Brechungsindizes für Probe und Vergleichsflüssigkeit nicht bekannt sind, kann man sie im Vorversuch mit Hilfe eines Abbe- oder eines Eintauchrefraktometers annähernd feststellen.

Abhängigkeit der Meßgenauigkeit von der Kammerlänge

Da nach den vorhergehenden Ausführungen die Länge der Kammern von verschiedenen Fragen abhängig ist, die nur der Benutzer selbst beantworten kann, sind in der Bestelliste die Grundausrüstungen des Interferometers ohne Kammern angegeben.

Die **Gaskammern** (8 Bild 2) werden — zur Messung aggressiver und nicht-aggressiver Substanzen — aus Glas mit angeschmolzenen Abschlußfenstern in Längen von 100, 50, 25 und 10 cm hergestellt. In den normalen **zweiteiligen** Gaskammern können direkt nur binäre Gasgemische gemessen werden. Zur quantitativen Analyse eines Gemisches von drei Gasen, z. B. Rauchgas mit Kohlensäure und Kohlenoxyd, empfiehlt sich die Anwendung der **dreiteiligen** Gaskammern, von denen die 1-m-Kammer aus Glas demnächst lieferbar ist. Diese Kammer ist außerdem für Stoffwechselbestimmungen vorgesehen; die hierfür erforderlichen Zusatzgeräte stehen uns jedoch vorläufig nicht zur Verfügung.

Flüssigkeitskammern (Bild 5) haben ebenfalls mit den Glasteilen säurefest verschmolzene Fensterplatten und werden für die Schichtdicken von 80, 40, 20, 10 und z. Zt. noch 5 mm geführt. Zu den Kammern gehören der gegen die Gaskammern auswechselbare Temperiertrog mit Rührer und ein Thermometer. Der Flüssigkeitsbedarf ist für je 1 cm Schichtdicke 1 cm³ Probenmaterial. Für Messungen von wäßrigen oder schwach alkoholischen Lösungen, bei denen nur etwa 0,1 cm³ Probenmaterial zur Verfügung steht, wird die aus vergoldeten Metallteilen hergestellte und mit ange kitteten Fensterplatten versehene 10-mm-Kammer mit 9-mm-Einsatz benutzt. Diese Kammer ist in Bild 5 mit dargestellt. Durch den Einsatz (c) wird die wirk-same Schichtdicke mittels je einer planparallelen Glasplatte in jeder Kammerhälfte auf 1 mm herabgesetzt.

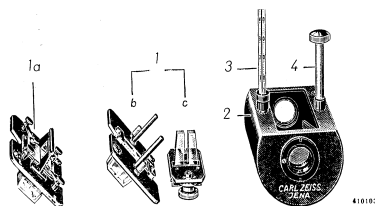


Bild 5. Flüssigkeitskammern mit Temperiertrog

1 Flüssigkeitskammern (a Kammer 20 mm aus Glas, b Kammer 10 mm aus Metall mit c Einsatz 9 mm), 2 Temperiertrog, 3 Thermometer, 4 Rührer

Bestimmung der Kammerlänge

Entscheidend für den Einsatz eines Interferometers ist in erster Linie die hohe Empfindlichkeit des Verfahrens und die damit verbundene enge Fehlergrenze der Messung, die ihrerseits von der gewählten Kammerlänge bzw. Schichtdicke abhängt.

Je größer die Kammerlänge ist, desto genauer ist die Messung durchführbar, d. h., die Meßgenauigkeit wächst mit der Kammerlänge. Andererseits wird jedoch durch eine größere Schichtdicke der Meßbereich verringert, so daß also die Konzentration des zusätzlichen Stoffes in der untersuchten Substanz eine gewisse Grenze nicht überschreiten darf. Bevor man mit einer Messungsreihe beginnt, muß man deshalb feststellen, welche Kammer sowohl die verlangte Genauigkeit als auch den erforderlichen Meßbereich einhält. Nach den im folgenden mitgeteilten Formeln läßt sich die günstigste Kammerlänge errechnen und damit die **zweckmäßigste Ausrüstung des Gerätes** bestimmen.

Zur Wahl der Kammerlänge handelt es sich bei Gasanalysen zunächst um folgende Fragen:

- Welches Gemisch soll untersucht werden?
- Welche Brechungsindizes haben angenähert die Komponenten?
(Die Werte des Vergleichsgases n_1 und der Zusatzkomponente n_2 sind Tabellenwerken, z. B. Landolt-Börnstein oder F. Löwes Optischen Messungen, 5. Aufl., S. 266, zu entnehmen.)
- Welcher %-Gehalt p_{\max} der Zusatzkomponente soll höchstens gemessen werden?
- Welcher %-Gehalt p_{\min} der Zusatzkomponente soll mindestens feststellbar sein, oder welche Genauigkeit wird verlangt?

In jedem Fall wird man die Kammerlänge möglichst groß wählen, um eine hohe Meßgenauigkeit zu erzielen. Jedoch ergibt sich durch die Beantwortung der Frage c, daß die Kammer höchstens

$$l_{\max} = \frac{5,5}{p_{\max} (n_2 - n_1)} \text{ mm}$$

lang sein darf, um den geforderten Meßbereich von $p_{\max}\%$ zu umfassen¹⁾.

Umgekehrt ergibt die Antwort zu d eine untere Grenze für die Kammerlänge, und zwar muß die Kammer mindestens eine Länge von

$$l_{\min} = \frac{2 \cdot 10^{-3}}{p_{\min} (n_2 - n_1)} \text{ mm}$$

¹⁾ Die Zahl 5,5 ist aufgerundet der 10000fache Wert der Wellenlänge $\lambda = 546,1 \cdot 10^{-3} \text{ mm}$, mit deren Licht die Absoluteichung des Interferometers durchgeführt wird. In der jedem Gerät beigegebenen Gebrauchsanweisung CZ 32-G 205-1 ist dieser Vorgang ausführlich beschrieben.

Bild 2 zeigt den äußeren Aufbau des Laboratoriums-Interferometers, bestehend aus Fernrohr, Rohrkörper und Kollimator. Die Schutzkappe des Kollimators trägt gleichzeitig die Beleuchtungseinrichtung.

Die wirksamen optischen Teile des Gerätes sind im Innern des Rohrkörpers fest eingebaut.

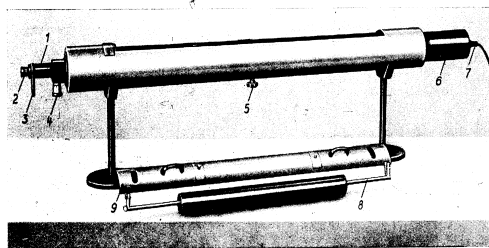


Bild 2. Laboratoriums-Interferometer (etwa $\frac{1}{10}$ nat. Größe)

1 Fernrohr, 2 Okular, 3 Ableselupe, 4 Meßtrommel, 5 Kreuzgriffschraube, 6 Schutzkappe für Kollimator, 7 Beleuchtungseinrichtung, 8 Gaskammer, 9 Deckel

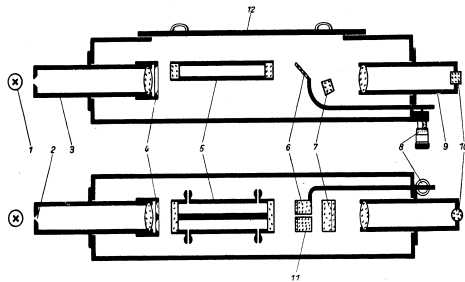


Bild 3. Schematische Darstellung des Laboratoriums-Interferometers

1 Lichtquelle, 2 Spalt, 3 Kollimator, 4 Doppelblende, 5 Gaskammer, 6 bewegliche Kompensatorplatte, 7 Hilfsplatte, 8 Meßtrommel, 9 Fernrohr, 10 Okular, 11 feste Kompensatorplatte, 12 Deckel

Aus der schematischen Darstellung in Bild 3 ist der optische Aufbau des Laboratoriums-Interferometers zu erkennen. Das von einer Glühlampe (1) durch den Spalt (2) fallende und durch das Kollimatorobjektiv parallel gerichtete Lichtbündel wird von der Doppelblende (4) gebeugt. Durch die Hilfsplatte (7) werden die unterhalb der Kammer verlaufenden Hälften der Lichtbündel vor dem Eintritt in das Fernrohr (9) so nach oben abgelenkt, daß im Okular (10) das untere Interferenzstreifensystem vom oberen nur durch eine schmale, waagerechte Linie getrennt erscheint. Das untere Streifensystem wird von der Füllung oder Leerung der Kammer nicht berührt und bewahrt immer seine feste Lage und sein gleiches Aussehen.

Die oberen Hälften der Lichtbündel gelangen durch die beiden Kammerhälften und die Kompensatorplatten (6, 11) ebenfalls in das Fernrohr und erscheinen im Okular als das obere bewegliche Streifensystem. Ist die Lichtbrechung der in beiden Kammerhälften befindlichen Medien verschieden, so tritt in den oberen Hälften der parallelen Lichtbündel eine Phasenverschiebung ein, die, je nach der Größe des Brechungsunterschiedes, ein völliges Verschwinden (Bild 4a) oder eine geringere Verschiebung (Bild 4b) des oberen Interferenzstreifensystems zur Folge hat.

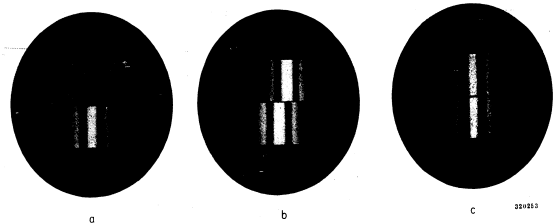


Bild 4. Interferenzstreifen, Meß- und Vergleichssystem (schematisch)

Indem man die Schräglage der Kompensatorplatte (6 Bild 3) ändert, wird der Lichtweg innerhalb derselben verkürzt oder verlängert und damit ein Ausgleich für die Verschiebung des oberen Streifensystems herbeigeführt (Bild 4c).

Die Einstellung auf gleiche Lage und gleiches Aussehen beider Interferenzstreifensysteme erfolgt durch einen die Kompensatorplatte (6 Bild 3) bewegenden Hebelarm, der durch Drehen der Meßtrommel (8) verstellt wird. Der Wert der Verstellung wird an beiden Teilungen der Meßtrommel abgelesen und stellt das Maß für den Brechungsunterschied zwischen Vergleichsstoff und Probe dar.



Bild 1. Laboratoriums-Interferometer

Das Laboratoriums-Interferometer wird für die Untersuchung von Gasen u. a. angewendet in

physikalischen, physikalisch-chemischen und chemischen Instituten
Glühlampenfabriken und in der Industrie der Gase
Gummi- und Linoleumfabriken
Bergwerken
Kliniken und Tuberkuloseheilstätten

Zur Messung an Flüssigkeiten benutzt man es mit Vorteil in

Instituten für Wasseruntersuchungen
ozeanographischen Instituten
Nahrungsmitteluntersuchungsämtern
medizinischen Instituten
pharmakologischen und physiologischen Instituten
(Heilserumprüfungen, Blutuntersuchungen usw.)

sowie für zahlreiche andere Bestimmungen

Daten

Meßbereich: 5 bis 5000 Einheiten der 5. Dezimale des Brechungsunterschiedes Δn , unterteilt je nach Kammerlänge

Fehlergrenzen: 2 Einheiten der 8. Dezimale bis 2 Einheiten der 5. Dezimale des Brechungsunterschiedes Δn , ebenfalls je nach Kammerlänge

Vorwissen über Interferometrie

Das Meßverfahren beruht auf der zahlenmäßigen Bestimmung der Differenz zweier verschiedener optischer Wege, die von zwei Lichtbündeln gleichen Ursprungs durchlaufen werden. Bei der Justierung des Gerätes wird dafür gesorgt, daß die geometrischen Lichtwege genau gleich groß sind. Die Verschiedenheit der optischen Wege beruht dann allein auf dem Unterschied der Brechungsindizes der vom Licht durchsetzten Medien.

Während mit Refraktometern der Brechungsindex selbst bestimmt wird, mißt man im Interferometer unmittelbar den Unterschied in der Lichtbrechung zwischen Probe und Vergleichssubstanz. Die Größe dieser Differenz hängt außerdem von der durchsetzten Schichtdicke ab, mit der die Meßgenauigkeit proportional wächst.

Unter den optischen Meßgeräten, die geeignet sind, die zum Teil mühsamen chemischen Analysen durch einfache physikalische Messungen mit engen Fehlergrenzen zu ersetzen, nimmt das Laboratoriums-Interferometer eine besondere Stellung ein¹⁾. Seine hohe Empfindlichkeit gestattet, Zusätze von wenigen hundertstel Prozent bei optisch empfindlichen oder von ein bis zwei zehntel Prozent bei optisch weniger empfindlichen Gasgemischen mühelos zu messen. Bei der Untersuchung von Flüssigkeiten sind die Fehlergrenzen so eng, daß sich eine etwa hundertfache Meßgenauigkeit gegenüber der refraktometrischen Bestimmung ergibt. Die Handhabung des Interferometers ist einfach und auch von Hilfskräften rasch zu erlernen. Die Bedienung der Meßvorrichtung erfolgt durch eine einzige Schraube, mit der zwei im Okular sichtbare Interferenzstreifensysteme auf gleiche Lage zueinander eingestellt werden.

Die Bilder sind nicht in allen Einzelheiten für die Ausführung der Geräte maßgebend. Für wissenschaftliche Veröffentlichungen stellen wir Druckstöcke der Bilder oder Verkleinerungen davon, soweit vorhanden, gern zur Verfügung. Die Wiedergabe von Bildern oder Text ist ohne unsere Zustimmung nicht gestattet. Das Recht der Übersetzung ist vorbehalten.

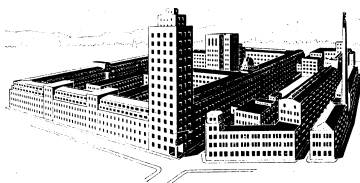
VEB CARL ZEISS JENA
 Drahtwort: Zeisswerk Jena Fernsprecher 3541

¹⁾ vgl. Schriftumsverzeichnis S. 12 bis 14



ZEISS

Laboratoriums-Interferomet



PRODUCTION PROGRAMME

Microscopes	Opto-mechanical Instruments for Measuring and Checking of Lengths, Screw-Threads and Profiles	16 mm. Silent-Film Portable Projector
Projection Microscope „Lanometer“	Instruments for Checking Angles, Angular Divisions, and Alignments	Epidiascopes
Photomicrographic Apparatus	Profile Projectors	X-Ray Diascope
Microprojection Apparatus	Interference Comparator	Miniature Slide Projectors
Luminescence Equipment	Gauge Blocks	Writing Projector
Microscopy and Photomicrography Supplementary Devices	Interference Microscope	Macro Projector
Electron Microscope	Double Prismatic Squares	Luminous Arrow
Calposcopes	Levels	X-Ray Screen-Image Cameras
Surgical Microscope	Theodolites	Documentation Recording and Reading Equipment
Operating Room Illuminants	Reducing Tacheometers	Developing and Drying Equipment for 35 mm. and 70 mm. film
Oral Illuminator	Supplementary equipment	Film Developing Tank
Aural Magnifier	Mirror Stereoscope with Tracing Stereometer	Prism Binoculars
Polarizer Spectacles	Photoheadolite	Opera Glasses
Instruments for Eye Examination	Stereo-Comparator	Sighting Telescopes
Apparatus for the determination and testing of spectacles	Stereo-Autograph	Telescopic Magnifiers
Magnifiers	Stereo-Planigraph	Refractors
Refractometers	Precision Coordinatograph	Astroglyphs
Interferometer	Rectifying Apparatus	Reflector Telescopes
Polarimeters	Photo-electric cells	Zenith Telescopes
Pulfrich Photometer	Photo-resistance cells	Transit Instruments
Abbe Comparator	Alkali-cells, Measuring cells, and special type cells	Spectrographs
Monochromators	Secondary Electron Multiplier with mains aggregate	Coordinate Measuring Apparatus
U. V. Spectrograph Q 24	Ultrasonic Equipments	Flicker Comparator
Photoelectric Photometers	Quartz Oscillators	Domes
Infrared Spectrophotometer	Synthetic Optical Components	School and Amateur Telescopes
Galvanometers	Gray and colour wedges	Terrestrial Telescopes
Electrometer	Photographic Lenses	Planetaria
Schlieren Equipment	Cine Recording and Projection Lenses	High-class point-focal ophthalmic lenses
Hand Spectroscopes	Process Optics	Infrared protective lenses
Konimeter	Werra-Camera	Umbra-tinted Sun-Glasses
Mechanical Instruments for Measuring Lengths and Screws Threads	Exposuremeter	Aspherical Cataract Lenses
Gear Testing Instruments	35 mm. and 16 mm. Sound-Film Portable Aggregates	Bifocal Lenses
		Contact Lenses
		Telescopic Spectacles
		Magnifier Spectacles

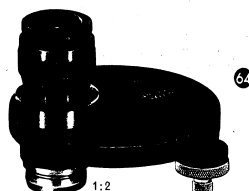
Please apply for literature

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ALPHABETICAL INDEX

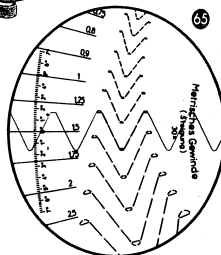
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Camshaft Tester	49	15	24-420-1
Clock Gauge	5	3	20-176-1
Coincidence Level	46	14	24-441-1
Installation Microscope	22	7	22-277-1
Contour Projector 200	36	12	24-313-1
Contour Projector 320	37	12	24-311-1
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Optical Universal Bevel	44	14	24-425-1
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Parallel Tester	13	5	20-161-1
Precision Gauge	14	5	20-151-1
Precision Gauge with fixture	15	5	20-151-1
Precision Magnifier	16	5	24-485-1
Precision Measuring Microscope	23	7	24-481-1
Precision Micrometers	3	2	20-130-1
Projection Optimeter 0.001 mm.	30	10	20-226-1
Projection Optimeter 0.0002 mm.	31	10	20-226-1
Schmaltz Surface-Finish Tester	34	11	24-460-1
Screw Gauge on Fixture	2	2	20-132-1
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Universal Horizontal Metroscope	29	9	20-236-1
Universal Measuring Microscope	27	9	20-250-1



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1:2



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64. Dial Templet Ocular

For form tests on profiles in conjunction with our Tool Microscopes, Universal Measuring Microscope and Microscopes for installation in machines etc. Integral and rotatable templets marked to show standard profiles, e.g. thread profiles, arcs, circles etc. Eleven different dial templet oculars can be supplied. Ocular magnification: 10X. Viewing field ϕ : 210 mm. apparent.

65. Visual Field in Dial Templet Ocular W. 2

Showing the most common standard profiles for metric threads according to DIN 13, DIN 243 to 247, DIN 516 to 521 (pitch of 0.2 to 6 mm.) and for Whitworth threads to DIN 11, DIN 239, DIN 240 and 259 (number of threads 60 down to 4 per inch). Also supplied with various double angle scales and markings.

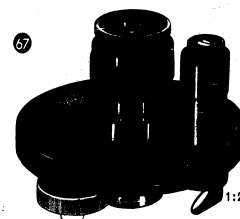
66. Double-Image Ocular

Auxiliary optical instrument for the rapid measurement of distances between bore centres, marks, etc. In conjunction with our Universal Measuring Microscope and our Tool Microscopes, Measuring procedure: Double reflected images of the object under view are made to coincide by moving the measuring slide. By each time reading off the position of the slide, the value is indicated by the difference between the first and second reading.



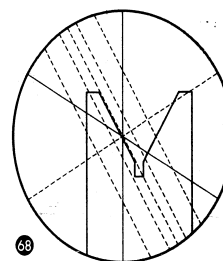
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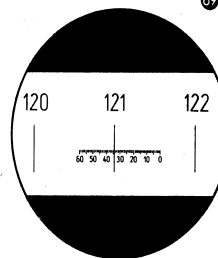


67

1:2



68



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67. Goniometer Ocular

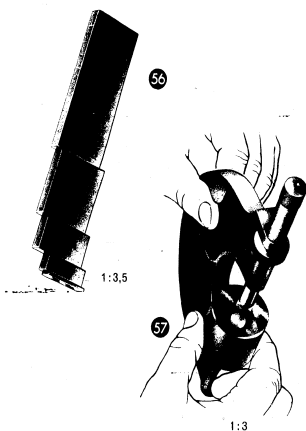
Complementary instrument to our Tool Microscopes, our Universal Measuring Microscope and our microscopes for installation in machines etc. For measuring angles of threads, tools, gauges, patterns etc. Integral, rotatable template with scale indicating 0 to 360° and with cross-lines. Fixed template with minute-scale. Ocular magnification: 10X. Viewing field diam.: 210 mm. apparent.

68/69. Visual Field in Goniometer Ocular

With cross-line templet, degree and minute scale as well as 5 dotted, parallel guide lines for flank diameter measurements with knife-edges (axial sectioning method). Distance between guide lines and point of intersection of annular lines corresponds to the distance of the knife-edge hair lines from the edge of the knife-edge. (Knife-edge hair lines replace the invisible flank lines of a thread profile during measurement of flank diameters by the axial sectioning method.)

56. Standard Gauge Blocks

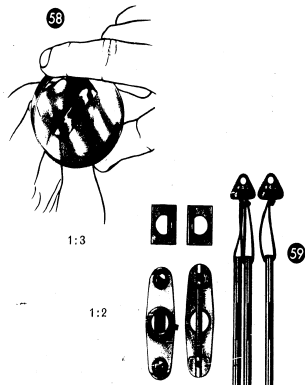
Engineering length standards. Machine lapped measuring surfaces of extremely high quality. Non-corrosive steel of highest volumetric constancy. Highest stability of dimension. Supplied in two sets of 45 and 86 pieces and also singly. Degree of accuracy 0 according to DIN 861. Accessories: Gauge block holder measuring jaws, Scriber and Centre point, Fiducial blocks.

**57. Optical Parallels**

For checking the parallelism and planeness of two flat contact surfaces and for determining periodic errors in precision screw gauges, external gauges, etc. Supplied in two sets of four pieces each 30 mm. \varnothing . Set 1: thickness 12,000; 12,120; 12,250; 12,370 mm. Set 2: 24,000; 24,120; 24,250; 24,370 mm. Greatest deviation from planeness ± 0.00015 mm. Greatest deviation from parallelism: $3''$ (seconds). Greatest thickness deviation: ± 0.0003 mm.

58. Optical Flats

For planeness tests of lapped gauging surfaces on an opto-physical basis. Criterion of measurement: Number and shape of the interference bands (distance between two bands in daylight ≈ 0.0003 mm). Supplied in 45 or 60 mm. \varnothing , 11 or 15 mm. thickness. Greatest deviation from planeness: ± 0.0001 or ± 0.0002 mm.

**59. (Thread Measuring Wires) Three-wire Sets**

Means for determining the flank diameter of external threads by the three-wire method. Used either in shoes or hanging free in eyelets on all measuring instruments having free motion of the contact plunger and plane measuring surfaces. When used in shoes the required anvil, spindle or contact plunger diameter is 8 mm. Supplied with wire diameters for practically all existing profiles and pitches.

60. Inspection Thermometer

For determining the testing temperature of the work and deviations from the fiducial temperature (20°C) in all precision measurements, also the difference in temperature of test piece and instrument. Range of temperature indicated: 16° to 26° . Scale reads to 0.2° . Equalisation time: 20 sec.

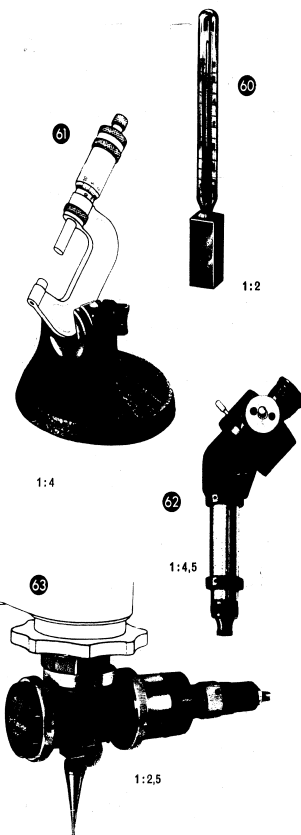
61. Universal Fixture for Measuring Instruments
Renders possible easy, secure and rapid measuring with precision screw gauges, external gauges and similar hand instruments, especially in the case of serial and thread measurements. Tilttable jaws and solid base.

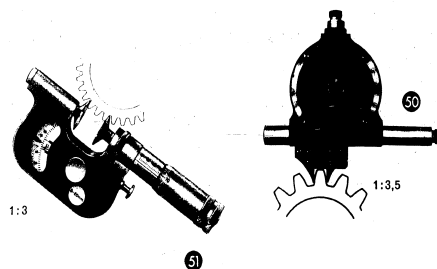
62. Spiral Microscope

For reading the millimeter scales of precision scales down to 0.001 mm.; 0.0001 mm. can be readily estimated. Used on precision measuring instruments such as our Universal Measuring Microscope, Universal Horizontal Metroscope, etc. Also suitable for installation in machines. Microscope magnification 60X. Diameter of viewing field: 130 mm. apparent.

63. Optical Contactor Lever

Contact instrument with optical indication showing the initial and final measuring positions of a measured distance. To be used in conjunction with our Tool Microscopes and our Universal Measuring Microscope. Versatile range of uses, e.g. for external and internal measurements, tests of alignment, parallelism and profile. Smallest contact aperture: 5 mm. Power: ≈ 10 g.





50. Optical Gear Tooth Micrometer

Hand instrument for measuring tooth thickness of spur and bevel gears. Reference datum in measurement is the addendum circle. Adjustable module slide. Tooth-depth setting and tooth-thickness are registered on two built-in glass scales. Contact prongs faced with hard metal. Module range: 1.5 to 18. Scale reads to 0.02 mm. Magnifier magnification: 34X.

51. Tooth-Span Indicating Micrometers

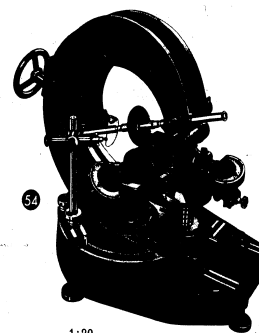
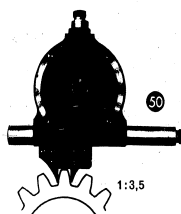
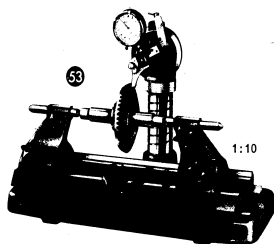
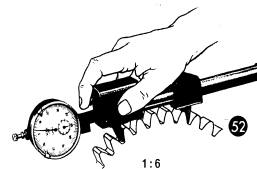
For direct and differential tooth-span measurements by the so called Wildhaber method. For use on straight and helical spur gears as well as helical gears with standard and modified involute teeth. Can be supplied in two sizes with tooth-width ranges of 0 to 20 mm. and 20 to 45 mm. Module range of size 1: from 0.5, of size 2: from 0.7. Micrometer scale reads to 0.01 mm, indicator reads to 0.002 mm.

52. Tooth-Spacing Measuring Instrument

Newly developed instrument for differential measurement of tooth spacing on gears of module 2 upward. Setting to standard gauge blocks. Free lift makes possible insertion of test piece without altering the standard setting. Deviation shown on dial gauge: down to 0.01 mm. Greatest measurable deviation from standard: ± 1 mm. Capacity: 45 to 160 mm.

53. Eccentricity Tester

For measuring eccentricity on spur, helical, bevel and worm gears also on cylindrical and conical surfaces of turned parts. Test pieces held between centres or in V-blocks. Measuring instrument: supplied either with precision indicator 0.001 mm. or 0.002 mm. or dial gauge, adjustable for height and with tilting range $\pm 90^\circ$. Interchangeable contact balls for module range: 0.3 to 4.0. Free lift: 3 mm. Internal contact lever for internal eccentricity measurements. Distance between centres: ≈ 300 mm. Height of centres: 100 mm.



54. Gear Testing Machine

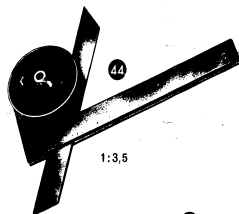
An instrument for the measurement of Base Pitch Circle, Tooth thickness, Width of space and Centricity on spur, bevel, helical and worm gears, and the pitch and eccentricity of notched index discs. Independent measurements, i.e. individual measurements are uninfluenced by the potential errors of any other element. Indicating measuring elements: 2 indicators with 0.001 mm. scale divisions. Interchangeable contact points with spherical or contact blades to suit each type of measurement. Incorporating Measuring bridge, rotatable and tiltable. Measuring range: gears up to 380 mm. ϕ . Module range: 0.5 to 10 mm.

55. Involute Tester

For the measurement of toothform errors of involute spur gears (external and internal). A contactor is made to scan the tooth flank and for all practical purposes describes a practically perfect involute with respect to the base-circle. Deviations from the specified form are indicated on a gauge with a scale division of 0.001 mm. and the error curve recorded on an electrical recording device at a magnification of 1,000X. Base circle range up to 207 mm. radius (7,876.6"), infinitely adjustable, reading with Spiral Microscope to 0.001 mm. Base Circle can be easily measured if unknown. Interchangeable stylus ball-points. Measuring range: gears up to 450 mm. (17.7165") ϕ . Working length between centres: 100 to 520 mm. (3,937" to 20,472"). Largest base circle to be set 414 mm. (16,1433"). Range of module: 0.5 to 10 mm. (50 DP to 2 1/2 DP).

44. Optical Universal Bevel

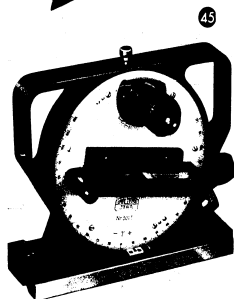
Striking, cross and mitre angle for the measuring, varying or marking of angles on gradients, workpieces, tools, gauges etc. Interchangeable rulers. Built-in circle of glass. The back is smooth and therefore suitable for marking out. Magnification of magnifier: 40X. Capacity: 4X 0 to 90°. Scale reads to 5'.



1:3,5

45. Optical Protractor Level with microscope

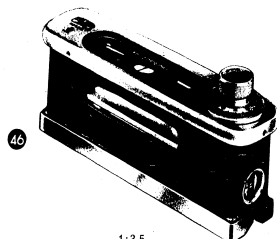
For the measuring and setting of angles (gradients) on plane or cylindrical surfaces and for levelling machines, jigs etc. Horizontal level (30°) to indicate measuring position. Diagonal level to prevent tilting errors. Built-in glass circle. Coarse and fine adjustment. Contact surface has a V-groove. Microscope magnification: 40X. Capacity: $\pm 120^\circ$. Scale reads to 1'.



1:3

46. Coincidence Level

Precision testing and measuring instrument for checking accuracy of angles and straightness of surfaces up to ± 10 mm/m. gradient. Built-in tubular level has a sensitivity of 20" per 2 mm. movement. By means of an optical arrangement, readable down to 2" (0.01 mm/m.). Solid housing protects level from disturbance by extraneous fluctuations in temperature. Contact surface has a V-groove.



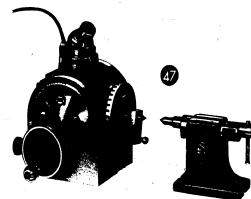
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1:3,5



47. Small Optical Dividing Head 100

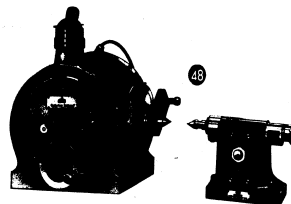
Instrument for checking and measuring index plates and angles in the manufacture of gears and similar precision parts. Especially suited for use on light machines. Built-in glass circle mounted on dividing head spindle. Dividing accuracy independent from mechanically stressed components. Height of centres: 100 mm. Swivel of spindle to the horizontal: -10° to $+110^\circ$. Capacity: 0 to 360°. Scale reads to 1'. Weight: approx. 18 kg.



1:8

48. Optical Dividing Head 130

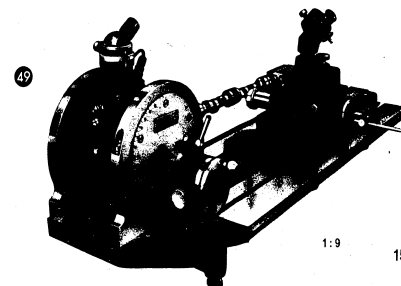
Precision checking and measuring instrument for division of angles. For use on heavy milling, grinding and drilling machines or on beds of 750 mm. or 1,600 mm. distance between centres. Pre-selector for setting minutes and seconds for the next operation while the current operation is going on. Height of centres: 130 mm. Swivel of spindle to the horizontal: 0 to $+90^\circ$. Capacity: 0 to 360°. Scale reads to 10'.



1:10

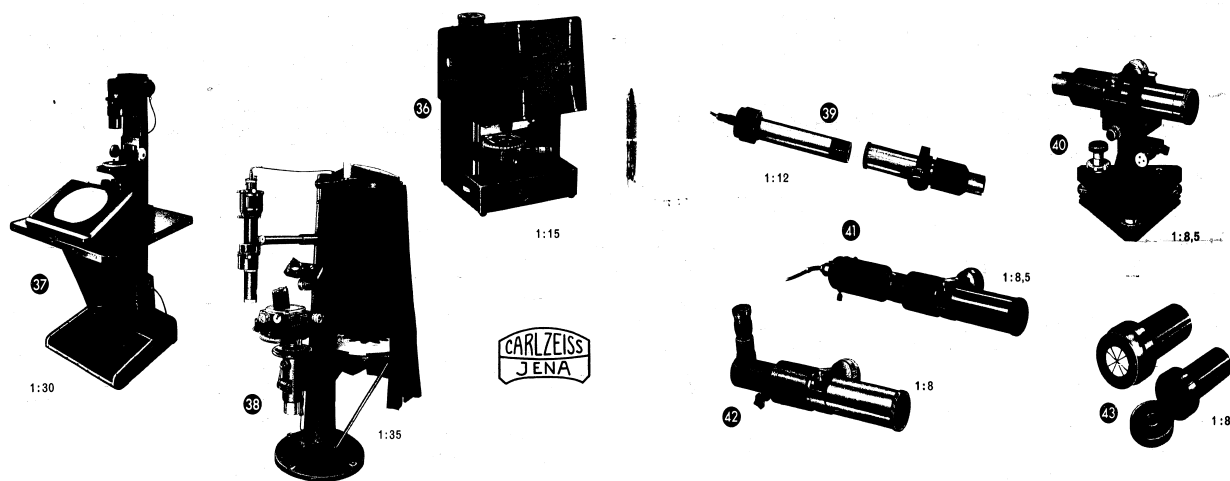
49. Camshaft Tester

For measuring valve travel in relation to angle of rotation (diagram of valve travel), checking the angle of both sides of the cam and checking the geometrical form of prototypes, master and work cams. Consisting Camshaft Tester, Optical Dividing Head 130 with headstock, Abbe microscope and bed for widths of centres 700 or 1,600 mm. Height of centres: 130 mm. Capacity of dividing head: 0 to 360°, of the measuring element: 0 to 100 mm. Scale of the dividing head reads to 10', of the measuring element 0.001 mm.



1:9

15



36. Contour Projector 200

Table instrument for transmitted and incident light projection in the testing of small production components e.g. in the clock and watch or fine mechanical industries. Telecentric path of rays. Interchangeable object stages (Sliding or co-ordinate stage). Curtain for exclusion of extraneous light during incident light projection. Magnification (optional) 10X, 20X, 50X. Area of projection: Ground glass screen 200 mm. ϕ .

37. Contour Projector 320

Transmitted and incident light projection instrument for testing form gauges, form parts, tools, gears, etc. For comparing profiles with transparency drawings, copying of projected profiles. Telecentric path of rays. Objectives and condensers housed in turrets so that rapid changes in magnification can be effected. Interchangeable object stages (sliding or co-ordinate stage). Attachable centre cradle. Curtain for exclusion of extraneous light during incident light projection. Magnification (optional): 10X, 20X, 50X. Area of projection: Ground glass screen 320 mm. ϕ .

38. Contour Projector 600

Transmitted and incident light projection instrument for a specially wide range of application, e.g. testing of form and rolling milling cutters, cutting, stamping and hobbing tools, gears, stencils and contour gauges, threads etc. Telecentric path of rays. Co-ordinate measuring stage, moveable in horizontal direction and vertically adjustable. Interchangeable objectives with magnification 10X, 20X, 50X. Curtain for exclusion of extraneous light during incident projection. Large areas can be measured and sections observed. Area of projection: white stage 600 mm. ϕ .

39. Aligning Telescope and Collimator

Optical instrument for determining alignment errors (parallel off-set, vertically and horizontally), angle deviations, especially in the construction of large machines. Used in conjunction with collimator, alignment and direction faults can be measured independently of one another. In conjunction with parallel plate attachment comprising two plane plates and a special target mark, it can be used for precision alignment tests. Telescope magnification: 30X. Target distances for alignment tests: approx. 0.7 to 40 m.; for direction tests: 0 to 25 m. Scale for testing alignment - using plane plate attachment - reads to 0.05, for testing direction: 1'.

Complementary Attachments

40. Tribrach for sensitive adjustment of the permanently located telescope towards given points or for setting up on flat surfaces (e.g. tables, plates, pedestals etc.) or on tripods as used for surveying instruments.

41. Projection Attachment for projecting the telescope graticule lines to any desired point in the target line in the range of 0.7 to 50 m., e.g. in shipbuilding for marking the wave-piercing point, etc.

42. Elbow Ocular, attachable to telescope for ease of observation in inaccessible places where observation in the line of the telescope is not possible.

43. Self-centring target mark, by means of built-in permanent magnet, adheres to the test piece, for rapid alignment of shafts and bearings in conjunction with the aligning telescope and collimator.



30. Optimeter

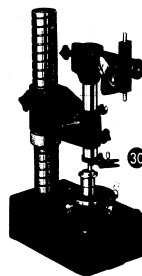
Opto-mechanical instrument for differential measurements. A measuring means for use in machines and measuring fixtures. In conjunction with measuring stands and suitable complementary components, suitable for checking lengths (thicknesses, diameters, etc.). Measuring principle: auto-collimation. Integral scale as measuring means. Readings appear in the ocular. Supplied with or without tolerance indicator. Capacity: 0 to 180 mm. Range: ± 0.1 mm. Scale reads to 0.001 mm.

31. Projection Optimeter 0.001 mm.

Opto-mechanical instrument for differential measurements. Operates in the same manner as the Optimeter, but the scale is projected on to a ground-glass screen. Reading can be observed without fatigue with both eyes. Solid measuring stand with coarse and fine vertical adjustment. Exchangeable stage and contact tips. Thread measurements by the three-wire method possible. Special fixture for measurements of wire. Free lift of plunger: approx. 3 mm. Capacity: 0 to 200 mm. Range: ± 0.1 mm. Scale reads to: 0.001 mm.

32. Projektion Optimeter 0.0002 mm.

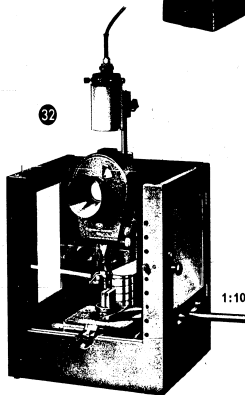
Construction and mode of operation same as for projection optimeter 0.001 mm. but scale reads to: 0.0002 mm. Used chiefly for checking gauge blocks. Stage with inspection thermometer interchangeable for other stages. Special cabinet to protect the instrument from disturbing extraneous temperature fluctuations. Free lift of plunger: approx. 3 mm. Capacity: 0 to 200 mm. Range: ± 0.02 mm.



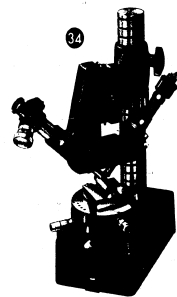
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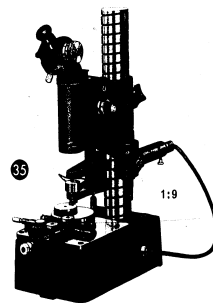
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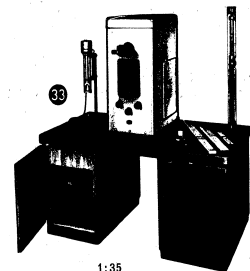
1:10



1:9



1:9



1:35

33. Interference Comparator

Fundamental instrument of measuring technology using light wavelengths as unit of measurement. For measuring final dimensions with the utmost attainable accuracy (approx. 0.00003 mm.). Protection from disturbing temperature influences by means of special insulated housing. Can be used for: direct measurements up to 125 mm., differential measurements: up to 200 mm., parallelism and planeness determination of gauge block surfaces, determining the coefficient of expansion of the gauge block material.

34. Schmalz Surface-Finish Tester

For measuring the depth of roughness and frequency of machining traces. Principle of operation: Profile view produced by light section. No mechanical contact with the surface to be measured, therefore, non-destructive measuring. Objectives interchangeable. Rigid or moveable stage (interchangeable). Photographic attachment as complementary accessory. Depths of roughness which can be measured: 0.0005 to 0.05 mm. Microscopic magnification (optional): 60X, 120X, 260X, 520X.

35. Diritest II

A new model of this instrument is in the designing stage.

24. Shop Measuring Microscope (0-50 mm.)

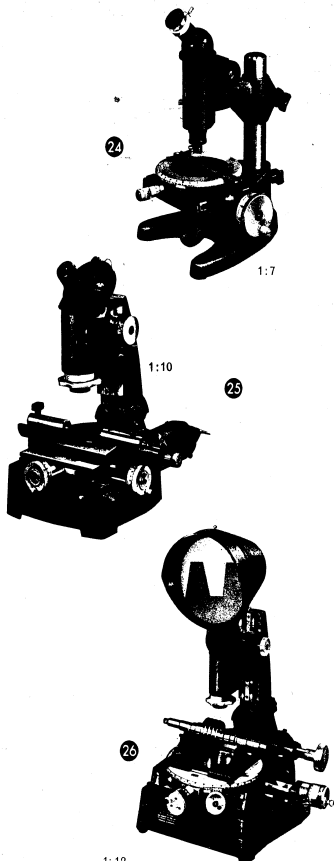
For lineal and angle measurements on transparent and non-transparent objects. Measuring stage moveable by means of precision adjusting screws in co-ordinates located at right angles. Microscope tube and measuring table adjustable for height to suit test pieces up to 70 mm. high. Focusing by means of rack and pinion. Range of measurement in X-direction: 0 to 50 mm., in Y-direction: 0 to 15 mm. Scale for X- and Y-directions reads to 0.01 mm.; circular scale: 1°; optical vernier: 6'.

25. Small Toolmakers Microscope

For lineal measurements in right angle co-ordinates, angle measurements on tools, gauges, etc. Comparison of profiles with drawing, measurement of all determinate dimensions of an external thread. Functions on the silhouette principle. Viewing microscope with coarse and fine height adjustment. Dial templet ocular and goniometer ocular interchangeable. Range in X-direction: 0 to 75 mm.; in Y-direction: 0 to 25 mm. Scale reads to 0.01 mm. Magnification (optionally): 10X, 15X, 30X and 50X. Complementary accessories: Projection attachment, photographic attachment, double image ocular, optical feeler.

26. Large Toolmakers Microscope

Applicability and auxiliary instruments same as for the small toolmakers microscope, with the addition of a revolving work stage. Silhouette method or sectional method optional. Range in X-direction: 0 to 150 mm., in Y-direction: 0 to 50 mm. Rotation of circular stage: 0 to 360°. Scales of X and Y drums reads to 0.01 mm. Circular stage graduated in 1°, optical vernier in 5'.



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27. Universal Measuring Microscope

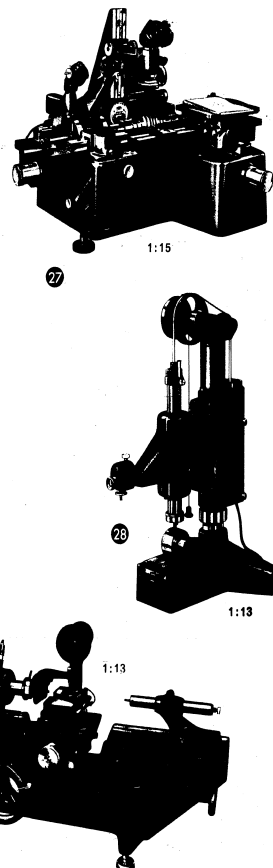
Precision instrument for practically all occurring measuring problems. Silhouette method and sectional method to choice. Incorporates precision glass scales as measuring components. Reading down to 1 μ in spiral microscopes, 0.001 mm. can be easily estimated. Coarse and fine adjustment of measuring carriage. Auxiliary instruments same as for small and large toolmakers microscopes. In addition: elevated centre cradle, centre cradle with circular scale, round stage with circular scale. Eccentricity testing attachment. Range in X-direction: 0 to 200 mm.; in Y-direction: 0 to 100 mm.

28. Abbe Vertical Metroscope

Opto-mechanical instrument for direct length measurements. Measuring means (high precision glass scale) built into measuring head. Reading down to 0.001 mm. in the spiral microscope; 0.0001 mm. can be readily estimated. Work-holding stage and contact tips can be exchanged according to shape of test piece (cylinders, balls, etc.). Suitable for thread measurements by the three-wire method. Capacities: 0 to 200 mm. Range of measurement: 0 to 100 mm.

29. Universal Horizontal Metroscope

Opto-mechanical instrument for direct external and internal measurements, e. g. of bores and internal threads. The bed may be complemented for numerous measuring and testing purposes. Horizontal measuring head with fine motion. Adjustable stage suitable for all requirements. Interchangeable contact tips. Special measuring mechanism with "magic eye" for pressureless measurements of from 1 mm. upwards. Capacities for external measurement: 0 to 450 mm.; for internal measurement: 1 to 200 mm.; for external thread diameters: up to 200 Ø; for internal thread diameters: 10 to 180 mm. Microscope scale reads to 0.001 mm.





18. Orthotest

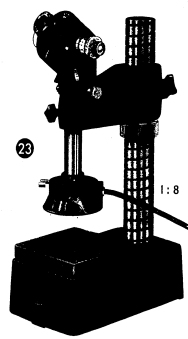
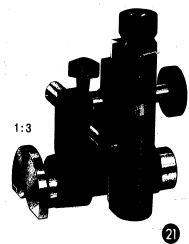
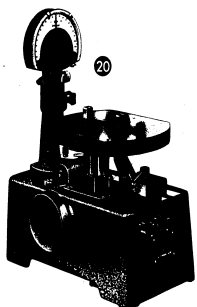
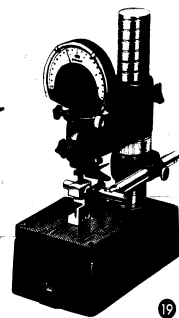
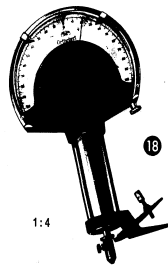
Differential measuring instrument, particularly suitable for use on machines as it is not affected by vibration. Adjustable tolerance marks. Interchangeable contact points with flat or spherical surfaces or knife-edge. Lifter for raising the spindle. Screw for fine adjustment. Free movement: approx. 5 mm. Spindle shaft: 28 Ø. Range: ± 0.1 mm or (with larger scale) ± 0.05 mm. Scale reads to 0.001 mm.

19. Orthotest for external measurements

Strongly built base with vertical coarse and fine adjustment. Interchangeable measuring stages for various uses. Special equipment for thread measurements by the three-wire method. Capacity: 0 to 180 mm. Range of Orthotest: ± 0.1 mm. or ± 0.05 mm. Scale reads to 0.001 mm.

20. Orthotest for internal measurements

For testing truth of bores. Instrument adjustable by means of adjusting rings, interchangeable spindles in pairs for the following capacities: 5 to 20 mm, with max. insertion depth 10 mm.; 13.5 to 90 mm, with max. insertion depth 25 mm.; 26.5 to 120 mm, with max. insertion depth 48 mm. Stage may be tilted for measuring the track diameter of outer ballraces. Range: ± 0.1 mm. Scale reads to 0.001 mm.



21. Lathe Microscope

Auxiliary instrument for use by the lathe operator for rapid alignment of the thread cutting tool in relation to the turning centres. Also for checking the grinding of the thread cutting tool and the flank angle of the thread after cutting. Templet ocular plate with 2 angles each of 60°, 55° or 30°. Alignment cylinder for clamping the instrument between centres, V-groove for attaching to workpiece. Rack and pinion height adjustment. Adjustable to right angle with turning axis. Magnification: 9X. Observation aperture: 10 mm.

22. Installation Microscopes

For installation into processing machines to test thread profiles in relation to standard on revolving templet ocular plates. With single ocular, suitable as an observation microscope for observing machine operations. Dial templet ocular and single ocular interchangeable. Spindle shaft: 38 Ø. Magnification: 30X. Viewing segment: 7 Ø. Object distance: approx. 57 mm.

23. Precision Measuring Microscope

For measuring lengths up to 3.5 mm or 7 mm, e. g., diameters of small bores, marking-off distances, grooves, gaps etc. Particularly suitable for measuring Brinell and Vickers hardening indentations. Ocular head can be moved through 90°. Adjustable glass scale on templet ocular plate. Measuring drum divided in 50ths. Instrument fitted with incident light attachment. May also be used as an ordinary observation microscope. Magnifications supplied: 25X or 50X. Glass scale reads to 0.5 mm. Drum graduated in 0.01 mm.

9. Dial Gauge

Differential and direct measuring instrument having a wide range of uses, e. g. radial and axial deviations, parallelism, lineal accuracy etc. Zero set by turning spindle. Interchangeable stylus inserts. Adjustable tolerance indicators. Unbreakable cover glass. Can be supplied with or without fixing lug. Spindle shaft: 8 ϕ . Range: 0 to 10 mm. Scale reads to 0.01 mm.

10. Dial Gauge Stand

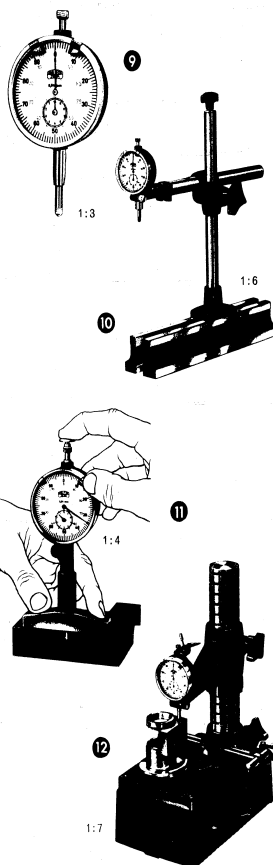
Complementary instrument for further uses of the dial gauge. Universally moveable, non-bending slide rods with solid base rail. Angle feelers and straight feelers (for internal measurements) and adjustable stop (for parallel movement along bevels and grooves). T-slot, rail-type base: 300 mm. Height of pillar: 280 mm.

11. Dial Depth Gauge

For direct measurement of depth (e. g. slots, grooves, closed bores, steps etc.). Interchangeable, hardened measuring spindles with flat or spherical surfaces. Solid base with plane ground and hardened surface. Capacity: 0 to 100 mm. Range of dial: 0 to 10 mm. Scale reads to 0.01 mm.

12. Dial Thickness Gauge

Instrument for single and serial measurements, principally differential measurements. Setting to a standard measurement. Strong stand with interchangeable measuring stages. Stop with locking screw for rapid measurement of test pieces of the same height. Dial gauge with lifting lever. Capacity: 0 to 180 mm. Dial reads: 0 to 10 mm. Scale reads to 0.01 mm.



13. Parallel Tester

For measuring deviations from parallelity of dovetail slideways of various profiles and widths. Interchangeable jaws with moveable slide-stones. In conjunction with a spirit level, it can be used as a measuring bridge. Groove widths which can be measured: 10 to 750 mm. Deviations from parallel: up to 1.1 mm. Scale of gauge reads to 0.01 mm.

14. Precision Gauge

Differential measuring instrument with 0.001 mm. or 0.002 mm. indicator. Can be used as gauging element in machines and testing devices. Spindle capable of being raised either by the knob, a Bowden wire or a lifter. Adjustable tolerance marks. Unbreakable dial glass. Spindle shaft: 8 ϕ . Free motion: approx. 3 mm. Range: ± 0.06 mm. or 0.12 mm. Scale reads to 0.001 or 0.002 mm.

15. Precision Gauge with fixture

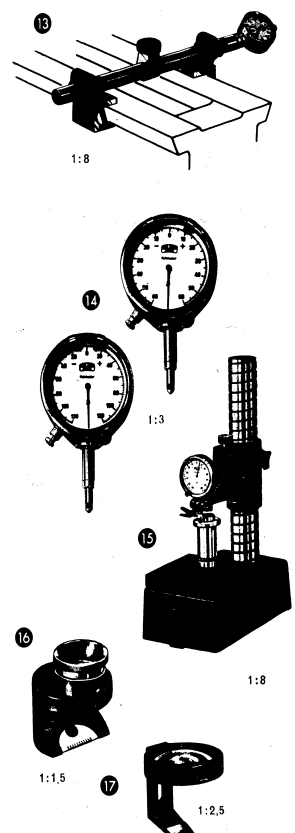
Table instrument for precise differential measurements. Zeroing to any standard measurement. Strong stand with interchangeable measuring tables. Coarse and fine height adjustment. Stop with locking screw for rapid measurement of test pieces of the same height. Capacity: 0 to 180 mm. Deviation indicated: up to ± 0.06 mm. or ± 0.12 mm. Scale reads to 0.001 or 0.002 mm.

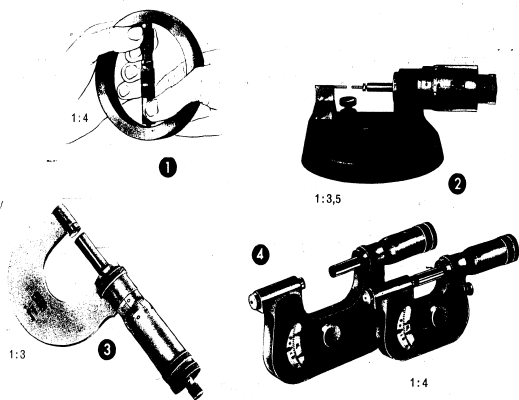
16. Precision Magnifier

Aplanatic magnifier for dividing short distances. Removed from holder, it may also be used as hand magnifier. Magnification 10X. Range: 0 to 10 mm. Scale reads to 0.1 mm.

17. Optical Vernier

Aid to exact and easy reading of millimeter scales. Observation distance: approx. 100 to 700 mm. Magnification: approx 2X. Scale reads to 0.1 mm.





1. Extendible Internal Micrometers

Internal Gauge for gauging bores and gaps from 50 mm. upwards, consisting of precision gauge screw and inserts, both having hardened metal ends and satin-chrome exterior. Supplied in 3 sets. Capacity: 50 to 1,500 mm. Scale reads to 0.01 mm.

2. Screw Gauge on Fixture

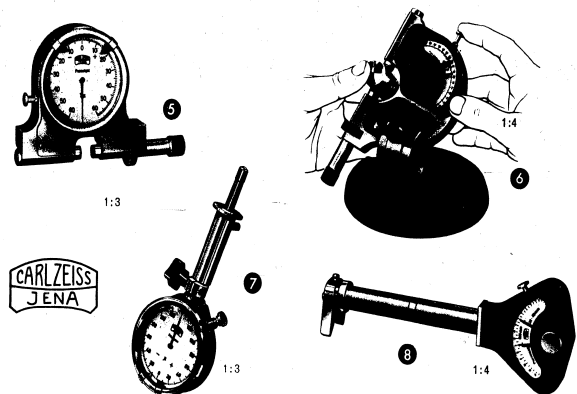
For external measurement of small production parts, especially in the Watch and Clock and Fine Mechanical Industries. Pressure action of the stylus against the surface being measured. Six pairs of interchangeable inserts with hard metal ends. Small adjustable object stage. Capacity: 0 to 25 mm. Drum divisions: 0.01 mm.

3. Precision Micrometers

External micrometers with hard metal gauging surfaces. Reduced inertia effect on contact effected by means of ratchet in drum (large dia.). Small milled screw effects rapid drive. Clamp ring to arrest gauge spindle. Frame and drum satin-chrome finish. Anvil and spindle diam.: 8 mm. Supplied in 4 sizes with a total range of 0 to 100 mm. Scale reads to 0.01 mm. All sizes suitable for measurements by the three-wire method.

4. Indicating Micrometers

Combination between micrometer gauge and adjustable snap gauge. Direct measurements with micrometer gauge, differential measurements with anvil. Adjustable tolerance indicators. Uniform measuring pressure. Hard metal ends. Free motion of anvil approx. 1.4 mm. Capacity of size 1: 0 to 25 mm., of size 2: 25 to 50 mm., of the indicator scale: ± 0.02 mm. Scale of the micrometer gauge reads to 0.01 mm., of the indicator scale: 0.002 mm. Thread measurements by the three-wire method possible.



5. Clock Gauge

Adjustable snap gauge with hard metal ends for differential measurement of small precision parts. Can be set to a standard setting and may be used either as a hand instrument or on a fixture. Adjustable tolerance indicators. Free motion: approx. 2 mm. Range: 0 to 10 mm. Measuring range: ± 0.06 mm. Scale reads to 0.001 mm.

6. External Gauge

Adjustable indicating snap gauge with indicator to show deviation from standard. Used principally for the testing and measuring of centre-ground and turned parts. Adjustable tolerance indicators. Hard metal ends. Free motion approx.: 2 mm. Supplied in 6 sizes with a total range of 0 to 150 mm. Range of sizes 1 to 4: ± 0.08 mm; of sizes 5 and 6: ± 0.150 mm. Scale of sizes 1 to 4: reads to 0.002 mm.; of sizes 5 and 6: 0.005 mm. Thread measurements by the three-wire method possible.

7. Small Bore Gauge

Dual point measuring instrument with automatic centring, for gauging small bore diameters. Interchangeable measuring heads. Adjustment by gauge rings. Adjustable tolerance indicators. Moveable sleeve to limit insertion depth. Total range: 2 to 11 ϕ . Deviation indicated: up to ± 0.12 mm. Scale reads to 0.002 mm.

8. Internal Gauge

Three point measuring instrument for examining bores for truth and geometrical form. Interchangeable measuring heads. Adjustment by gauge rings. Deviation indicated on indicator dial. Adjustable tolerance indicators. Supplied in 5 sizes with a total range of 11 to 120 mm. Deviation indicated, sizes 4 and 5: ± 0.070 mm; size 6 and 7: ± 0.14 mm; size 8: ± 0.17 mm. Scale reads to 0.002 mm and 0.005 mm.



PRODUCTION PROGRAMME OF PRECISION MEASURING INSTRUMENTS

In this pamphlet are listed briefly and concisely all the measuring instruments of our current production programme. Convince yourself of the versatile range of that programme and see which instruments you require in order to complete the equipment of your measuring room. Upon request, we shall be pleased to place at your disposal more detailed pamphlets dealing with the instruments in which you are interested.

Do not forget that these are Zeiss Precision Measuring Instruments upon which you can rely in every respect.

Remember, too, that gauging — accurate and reliable gauging — is of benefit to the quality of your products and contributes to the efficiency of your business.

Jena, April 1955

VEB Carl Zeiss JENA

Department for Technical Measuring Instruments

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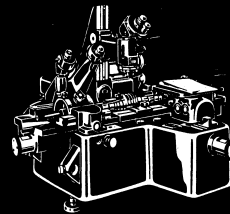
VEB Carl Zeiss JENA

Department for Technical Measuring Instruments

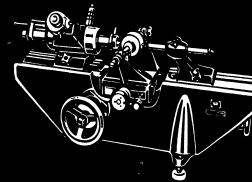
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Telephone: 35 41

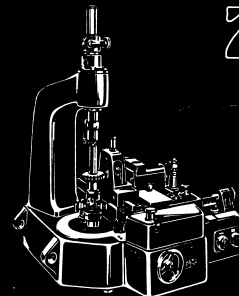
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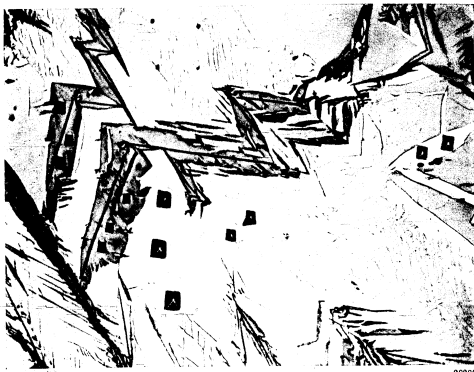


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ZEISS





Steel of 1.69% C. Comparison of hardness of tetragonal and cubical martensite and residual austenite. 800:1.

A special feature worth mentioning is the fact that the Hanemann Micro Hardness Tester may be used with test loads ranging from a very few grammes up to about 100 grammes.

As the applicability of this testing method is known in those various fields as f.t. in metallography, mineralogy, abrasives, cement works, slag smelting, glass works, etc., no particulars need be stated in this booklet.

Hanemann Micro Hardness Tester

consisting of:

Special type Apodromat D 30 x 0.65 in lamellar spring suspension and with Vickers diamond pyramid with optical test-load indicator (in container), 1 — set of calibration weights, eyepiece screw micrometer in centering house with two counter-current templates for forming a planimetric square with focusing compensating eyepiece x15, glass inset stops, in case

Catalogue No.	Code-word
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A special pamphlet is being prepared

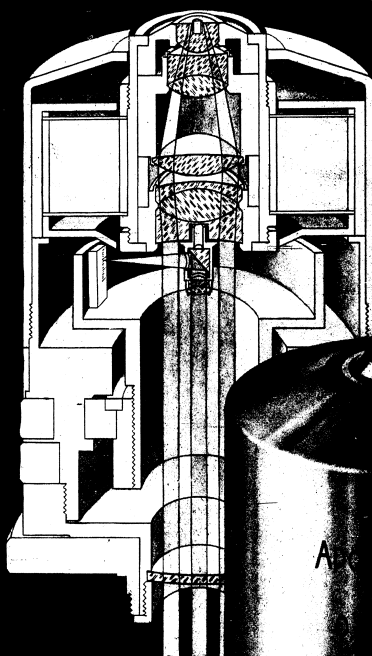
Unless otherwise stated the instruments listed in this booklet are intended for operation with 220V a. c.

Please apply for special quotation if the available voltage and kind of current vary from the above.

Illustrations herein are not to be considered binding as to details of design and are subject to change without notice. Full size or reduced printing blocks of illustrations, as far as available, will be supplied gladly to authors of scientific publications. Reproductions of illustration or text are subject to our consent. All rights, including that of translation, reserved.

OPTIK CARL ZEISS JENA VEB

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CARL ZEISS
JENA



Brazing of steel with "Cu-P" solder (transverse section). Test load 10 g., 500:1

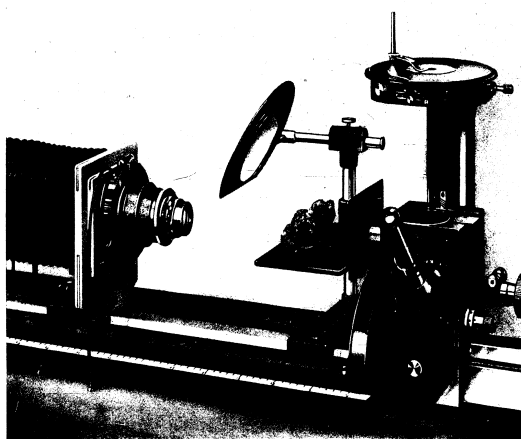
Hanemann Micro Hardness Tester

Since its first practical realization by the introduction of the Zeiss Hanemann type of Micro Hardness Tester, the micro hardness method of testing has been successfully adopted in many branches of engineering and technology. This opto-mechanical testing device, if used in conjunction with the Zeiss "Neophot", makes it possible to ascertain in the field of the microscope the mechanical properties of the most minute constituents of a structure.

By combining the Vickers diamond pyramid to form a complete entity with the microscope objective, his method of determining hardness enjoys a degree of responsiveness and reliability in fixing the point of impact which has not been attained so far by any other known method.

In most of the conventional hardness testing methods the macro-hardness is being tested so that these methods are not available for ascertaining the effects on the final reading as occasioned by factors such as the hardness of the different structural elements on one hand and their grain size and quantity-ratio, as well as by the distribution of the gliding-plane displacement at the grain boundaries on the other hand. Also the scratch hardness tests, — despite their instructive value in other respects — have failed to permit the testing of hardness of a certain constituent of a microscopical structure.

As the test loads required in the micro-hardness method of testing are so adjustable that the impressions produced remain smaller in size than the crystals under investigation, this testing method is not subject to any limitations except those given by the resolving power of microscope optics.



Equipment for Photo-Macrography

The optical equipment consists of high-class Apochromats which, thanks to their prominent correction, and in conjunction with Compensating Eyepieces or with Homals, satisfy exacting requirement. The objectives are corrected for infinity and for use without cover slips. Their mounts not being provided with the standard objective thread these objectives are only available for the incident-light type of microscopes fitted with an integral tube-lens.

By the introduction of newly computed plane-field achromats and plane-field apochromats the excellent optical performance of the "Neophot" will be receiving an additional impetus in the near future. The new type of objectives are "T"-coated and furnish a practically flattened field of view. Used in conjunction with special types of eyepieces the visual field they provide will be noticeably larger than that obtainable with the conventional combinations.

The equipment is completed by a special type of stage clip and by a Multiplier for determining the proper period of exposure.

For an important supplement to the "Neophot" please consult page 47 of this booklet, dealing with the Hanemann Micro-Hardness Tester.



Large Epi-Camera-Microscope "Neophot"

I. Basic Equipment (not including optics)

consisting of:

"Neophot"-Stand with mechanical stage, 9 x 12 cm. camera with Compound-shutter, dark slides and accessories, illuminant for visual observation including clock-feed arc lamp and electrical accessories for 10 Amp. a. c., Sub-structure with countersunk anti-vibration suspension, with drawers for the accessories and locking doors.

II. Optical Equipment

(Magnifications, visual, from 22 to 1800 x)

Triplet, 4-Apochromats, Huygenian and Compensation Eyepieces and 3-Homals.

III. Accessories for Dark-ground work

2-Metal inset-stops and 2 concave mirror condensers.

IV. Supplementary Device for Photography with Mikrotars

(imaging-scales 4:1 to 20:1)

Plane-glass holder and plane glass with accessories, 2 Mikrotars, 2 Illuminating lenses for Mikrotars and mirror attachment with ground-glass screen for plane-glass holder.

V. Supplementary Device for Photography using photographic objectives

(Imaging-scales 0.5:1 to 4:1)

Object stage with light screen as well as TESSAR in focusing mount.

VI. Additional Accessories

Special type of stage clip, split inset-stops, 9 x 12 metal dark slides, Multiplier and neutral filter.

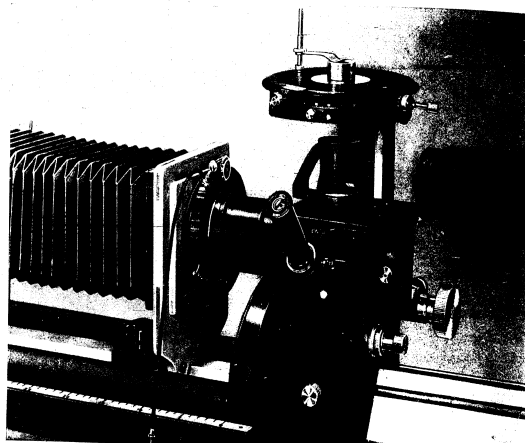
Complete Equipment (Items I to VI)

for 10 Amp. a. c.

Catalogue No.	Code-word
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For particulars regarding equipment of the "Neophot" please consult Price List CZ 30-P 675-1

A special pamphlet is being prepared



Equipment for low-power photography in bright field

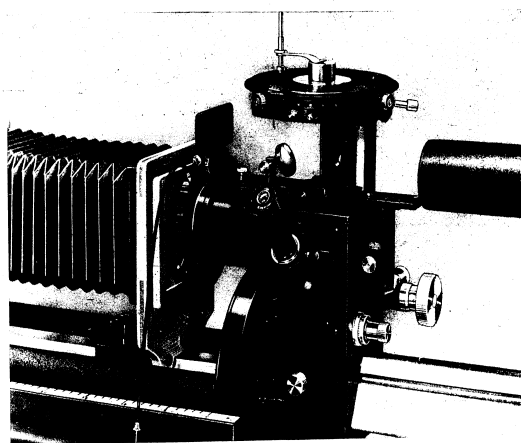
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The basic equipment of the "Neophot" comprises the following:

The microscope stand is provided with a rugged stage carrier admitting of the examination even of heavy specimens. The stage is of the rotatable and centering type. Coarse and fine adjustments are low positioned, the first acting upon the stage and the second upon the Vertical Illuminator. The coarse adjustment is facilitated by the coarse motion head being provided with focusing marks. The observation tube is situated for greatest convenience. Observation is possible both monocular and binocular. Changing over for projection onto the ground glass screen of the camera is effected by merely interposing a prism into the optical path.

The combined Vertical Illuminator is arranged for alternating between bright-field and dark-ground illumination. Bright-field observations are possible with plane-glass illuminator or prism, and dark-ground observations by using an annular mirror. The change-over from one method to the other is quickly and conveniently accomplished and permits the ready comparison of the different types of images. The employment of polarised light with the aid of polarising filters is possible. Please apply for particulars.

The anti-vibration mounting of the optical bench, on which the components are lined up, make the instrument available for work at all magnifications and thus protect it from external influences.



Equipment for low-power photography in dark-ground illumination

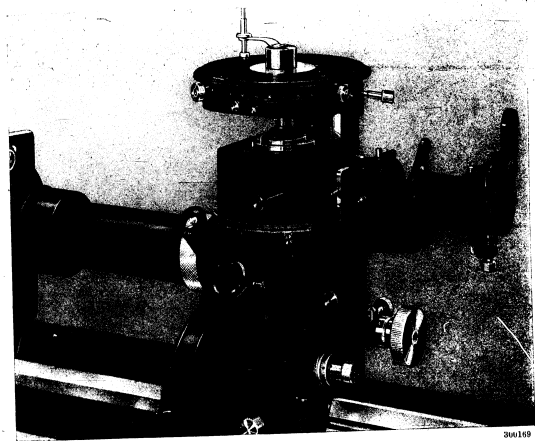
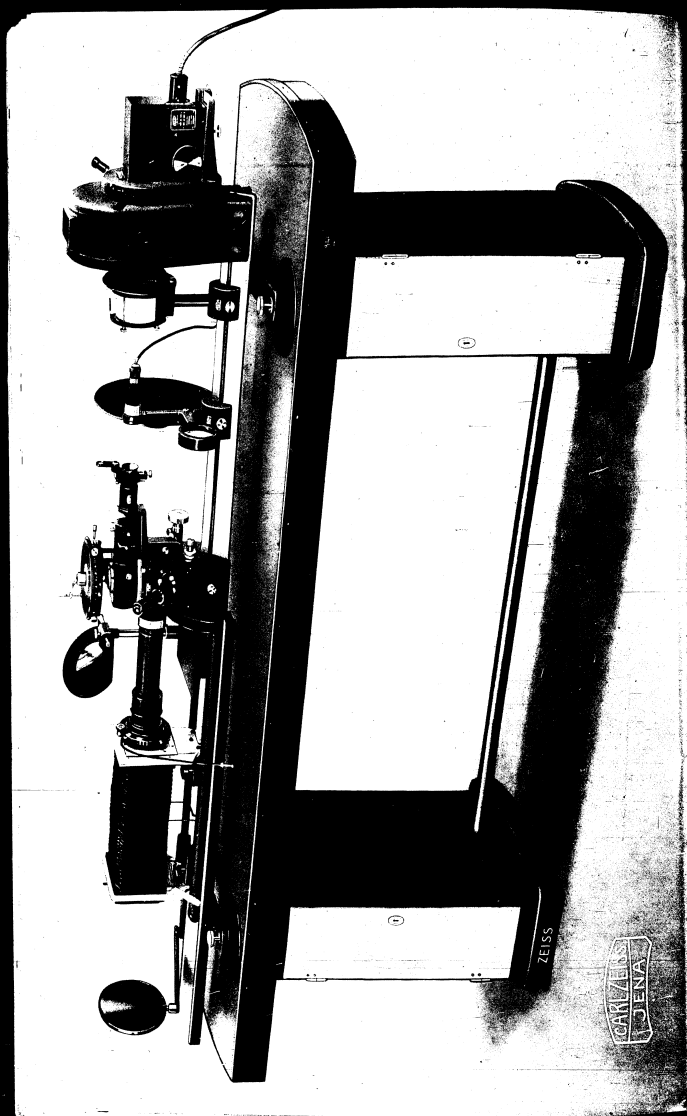
300167

In addition to a 9 x 12 cm. camera, which forms part of the basic equipment, provision is made for a 13 x 18 cm. camera. Also a miniature camera attachment, especially for colour photography, is now being prepared. The camera length can be read off as indicated on a linear scale alongside the optical bench. The focusing screen may be observed in a tiltable mirror from the operator's position at the stand. Coarse and fine motions may be comfortably operated at any position of the focusing screen by way of remote controls.

The illuminating device includes a clockwork feed arc-lamp as well as a low-voltage microscope lamp for visual observation. The arc-lamp is primarily used for photography and for dark-ground work.

For low-power survey photography the Vertical Illuminator is interchanged for an illuminator for Mikrotor objectives. Bright-field illumination is produced with the aid of the plane-glass illuminator and corresponding illuminating lens, while dark-ground illumination is obtained by means of a mirror and swing-out type of ground-glass screen.

The equipment for photo-micrography with a photographic objective can be quickly and easily installed.



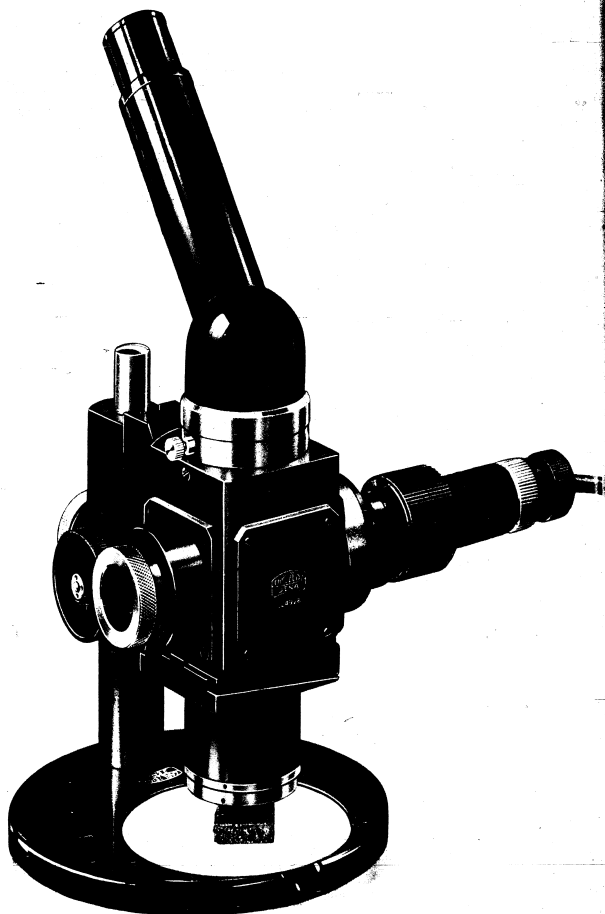
Vertical Illuminator for Bright-Field, Dark-Ground and Polarisation

Large inverted Epi-Camera-Microscope "Neophot"

The continuously growing importance of the testing of metal microsections for material investigation purposes has prompted us to incorporate into the new model of the "Neophot" some constructional features meeting present day requirements. While originally designed as a metallographic type of microscope the "Neophot" is also available for the investigation of ore, coal and minerals.

The "Neophot" is equipped for:

- 1) the visual observation at magnifications ranging from $22\times$ to $1800\times$, as well as for photography on a scale extending from $20:1$ to $1600:1$ both in ordinary bright-field with vertical and oblique illumination, and in dark-ground illumination.
- 2) production of low-power photographs on a scale ranging from $4:1$ to $20:1$ in bright-field at vertical examination with the plane glass and on dark-ground at oblique illumination with the mirror.
- 3) taking macro-photographs of larger size objects with a standard type of photographic objective on a scale from $0.5:1$ to $4:1$.



Epi-Microscope "Epignost"

This instrument has been designed to meet the demand for an incident-light microscope which conveniently and specifically adapts itself to the rapid checking of polished and unpolished surfaces.

The microscope and the illuminating device form one complete unit which is easily portable and not confined to use in the laboratory. Securely attached to a column the motion box of the microscope is conveniently adjustable in height. The total magnification is limited to about $\times 320$, focusing being effected by a coarse motion control. In addition to the "Neophot"-optics, as quoted below, the instrument will be equipped with plane-field objectives and specially computed wide-angle eyepieces so that the field achieved is a practically flat one.

Incident-light observation in bright field and dark ground may be carried out in quick succession. Bright field observations are possible either with the aid of the plane-glass or the prism. For dark-ground observations the frosted illuminating lens is interchanged for a slip-in diaphragm. The objectives are attached to slide-changers which, for dark-ground observation, are in addition provided with a concave mirror condenser. Dark-ground illumination has been found to be the most suitable illumination for objects of inferior reflectance and is likewise preferable for the observation of coloured components. The monocular inclined tube with quick-changing device may be swung in any optional observing direction. To arrive at the total magnification a tube-lens with a factor of 0.63 built into the tube will have to be taken into consideration.

Provision is being made to make the instrument available for work in polarised light with the aid of polarisation filters. Please apply for particulars. Supplementaries, as used with the "Citoplant" (cf. p. 35), may also be used in conjunction with the "Epignost". They include the transillumination base for low-power observations in transmitted light or for examinations in combined transmitted and incident light, as well as the spherical stage. Provision is made in the foot of the instrument for using our simplified type of attachable mechanical stage, if so required. As a light source the conventional type of 6V 15W low-voltage lamp is used.

Incident Light Microscope "Epignost"

for bright field observations with plane glass for magnifications from $\times 52$ to $\times 285$

consisting of:

Stand, motion box, tube, plane glass barrel and bright-field diaphragm, lamp house with collector and lamp mount with cable, in cabinet.

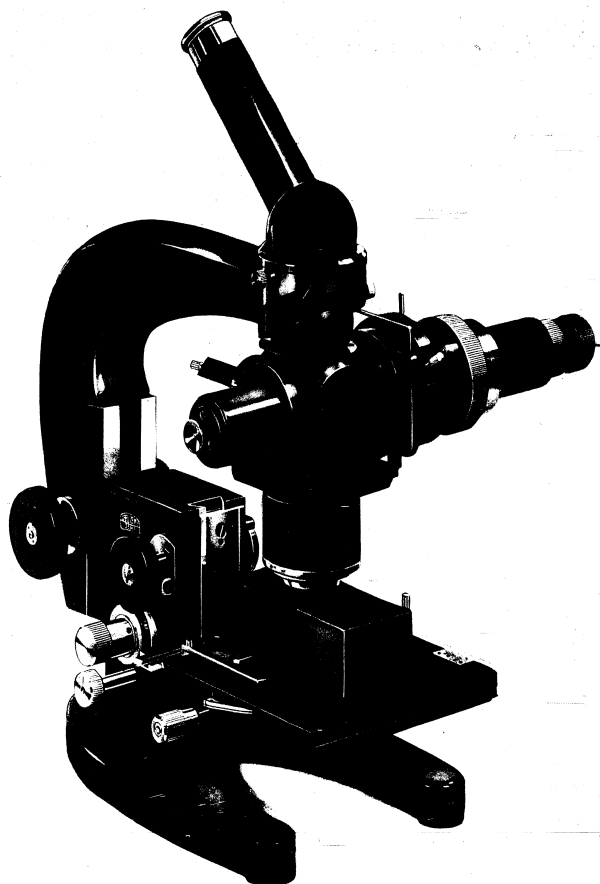
Monocular inclined tube (slip-in $\varnothing = 23.2$ mm.), two objective slide fittings, Triplet $\times 5.5/0.10$, Apochromat $\times 15/0.30$, Compensating eyepieces $\times 15$, $\times 20$, $\times 30$ (not including projection bulb and transformer, cf. p. 21).

Supplementaries:

Prism barrel for bright field
Dark-ground diaphragm
and
Concave mirror condenser 8 for Triplet $\times 5.5$
Concave mirror condenser 9 for Apochromat $\times 15$

Catalogue No.	Code-word
30 02 02	Kyoco
30 41 55	Kyodh
30 41 56	Kyoc
30 40 88	Kyold
30 40 89	Kyoge

A special pamphlet is being prepared



Large "LuG" Microscope with Incident Light Condenser

This new type of Epi-Condenser attaches to the microscope tube carrier by means of a dovetail slide. Its standard form consists of the illuminating tube with lamp and centring base, of the collector and change-over slide for bright-field and dark-ground illumination, of the housing containing a plane glass plate inclined by 45° with annular mirror, as well as of a prism. The prism and plane-lens may be interposed into the optical path by means of a slide. Our objectives being corrected for infinity, an extra lens had to be fitted into the tube. The factor of this lens, which amounts to 0.63, will have to be taken into consideration when figuring the total magnification. The change of objectives is effected with the aid of a slide-changer. The objectives will be supplied with the concave mirror type of condenser. The microscope is available for monocular as well as binocular observation. The Incident-light Condenser is designed only for use with the "Lu" type of stand and will not fit other "L"-class microscopes.

The possibility of employing dark-ground illumination makes the incident light condenser particularly useful for the examination of minerals in micro-section.

The Epi-condenser is contemplated to be arranged for work in luminescent light so as to make it available also for the examination of coal and lignite.

Besides the objectives as used with the "Neophot", provision has been made for employing flat-field objectives which, if used in combination with the respective eyepieces, furnish a practically flat-field.

For observations in polarised light, with the aid of polarising filters, the Epi-condenser will be equipped with a slip-in type of polariser and with a built-in analyser fitting. Flat-field Achromats are being prepared for this purpose. Please apply for particulars.

Recommendable Assembly:

Stand "Lu" with large square mechanical stage (75 mm. x 50 mm. movements), in cabinet, including Epi-Condenser consisting of: housing with illuminating tube and collector, plane-glass and prism as well as dark-ground mirror, lamp mount with cable, change-over slide for bright field with adjustable and centring iris, and change-over slide for dark-ground, 3 colour filters, diffusing and heat absorbing filters (not including 6 V 15 W projection bulb and transformer, cf. p. 21).

Monocular inclined tube L | Triplet 5.5 x/0.10 and Apochromat 15 x/0.30
2-concave mirror condensers | Apochromat 60 x/0.95
2-dovetail slides for objectives | Compensating eyepieces x 15, x 20 and x 30

Monocular Microscope LuG

with Epi-Condenser equipped as above
for magnifications from x 52 to x 760

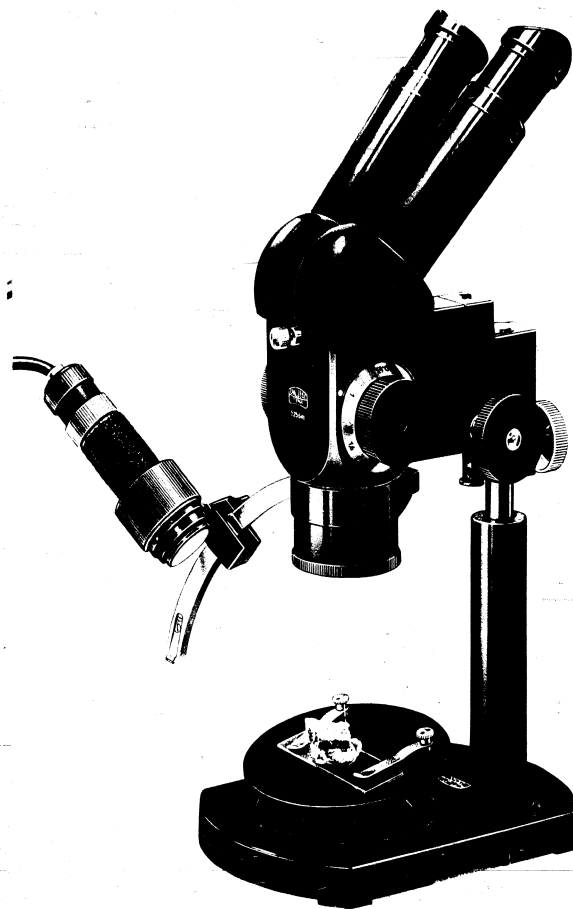
Catalogue No.	Code-word
30 00 35	Kyobz.

Supplementaries for binocular observation:

Binocular inclined body tube "Bitukni L" (cf. page 18). Two compensating eyepieces each x 10, x 15 and x 20 are required in conjunction with the body tube.

A special pamphlet is being prepared

0025



Stereo-Microscope "Citoplast"

The "Citoplast" presents a fundamentally new optical arrangement realising a number of long wished-for features. Above one single large-type objective a rotatable cylindrical device is disposed carrying small telescope-systems which, arranged in pairs, make it most convenient to change total magnifications without having to vary the permanent working distance of 100 mm. Magnifications extend over a range from $\times 4$ to $\times 100$.

The inclined double tube, fitted either with $\times 6.3$ or $\times 25$ paired eyepieces, may be swung about for use in two different observing positions.

The "Citoplast" is most excellently adapted for stereo-microscopic research and dissecting work calling for frequent and rapid changes in magnifications. Beyond this it will prove of great convenience for stereo-microscopic purposes in general.

Excepting the inclinable base, the supplementary parts listed at the foot of page 33 are available also for use with the "Citoplast" including transillumination base for transparent objects as well as the device for testing jewel-bearings, and others. The equipment may be completed by an attachable lamp which can be swung about the optic axis and varied from steep to grazing incidence of light.

Stereo-Microscope "Citoplast"

for magnifications from $\times 4$ to $\times 25$
comprising:

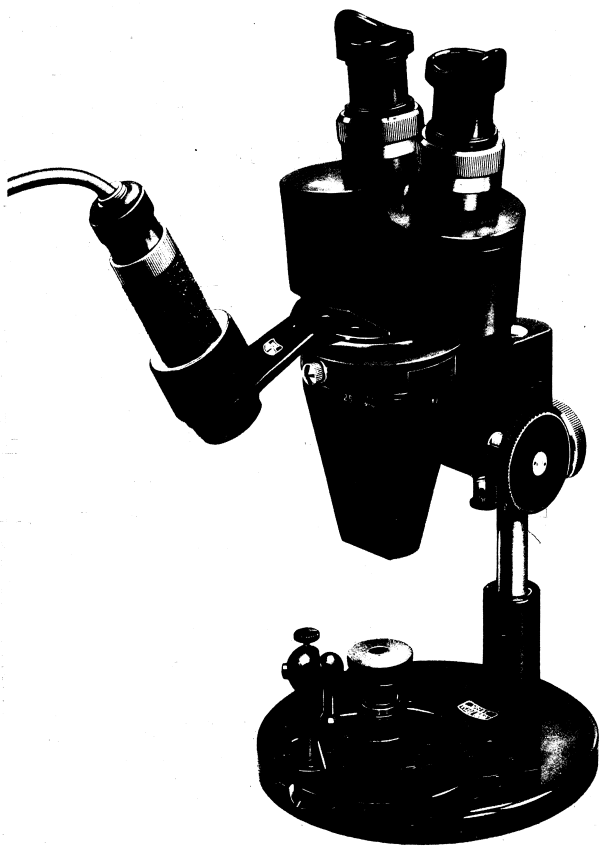
Stand with plate-inset, binocular image-erecting inclined body tube, integral magnification variator, vertically adjustable motion box, in cabinet (without lamp) with 2 eyepieces $\times 6.3$ and 2 attachable eye cups II.

Supplementaries:

- 2-eyepieces $\times 25$ for magnifications from $\times 16$ to $\times 100$
- Lamp including lamp-mount with cable (not including projector lamp and transformer, cf. p. 21)
- Ball stage (as illustrated at the left)
- Device for testing jewel bearings (cf. illustration, p. 32)
- Transillumination base (without lamp-mount, as the latter of the aforementioned lamp may be used)
- Hand rests (for two hands)

Catalogue No.	Code-word
30 01 00	Kymil
30 31 61	Kymnn
30 41 10	Kymoo
30 51 30	Kynyx
30 51 37	Kynzy
30 42 10	Kympp
30 50 50	Kyooy

For particulars please consult "CZ 30-157a-2"



Stereo-Microscope "PM XVI"

The "PM XVI" is a new form of the Greenough-type of Zeiss Stereo-Microscopes. It is of compact construction and its outstanding optical properties are a long working distance combining with a superb quality of image.

The instrument is equipped with four different pairs of eyepieces and three interchangeable pairs of objectives with a magnification ranging from $\times 2.5$ to $\times 63$. At lowest magnification the instrument presents as large a visual field as 70 mm. in diameter, viz., a singular optical performance not achieved heretofore. A swing-out type of lamp can be supplied, if so required.

The "PM XVI" is specially suited for continuous work such as the testing and checking of materials and production parts as well as for the supervising of delicate working processes in workshops, laboratories and investigating offices.

The equipment may be completed by supplementaries including a ball stage, transillumination base, device for testing jewel-bearings, hand rests, and a wooden base for inclining the stand.

The instrument is also of advantage for stereoscopic examinations and dissecting work in natural science and medical research.

Stereo-Microscope "PM XVI"

for magnifications from $\times 2.5$ to $\times 40$,
comprising:

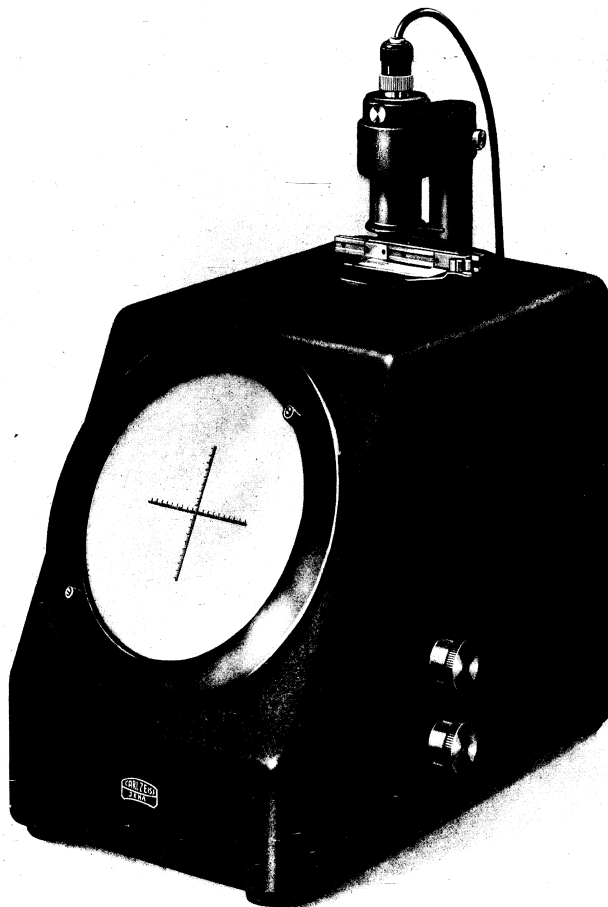
Stand on round base, with plate-inset, binocular image-erecting straight tube, vertically adjustable motion box, in cabinet (not including lamp), with paired objectives 0.4 and 2.5 and two eyepieces each $\times 6.3$ and $\times 16$, two attachable eye cups 1

Supplementaries:

Double Objective 1.0
2 eyepieces $\times 10$
2 eyepieces $\times 25$ for magnifications up to $\times 63$
Lamp including lamp-mount and cord (not including projector bulb and transformer, cf. p. 21)
Ball stage (cf. p. 34)
Device for testing jewel bearings (cf. illustration at the left)
Transillumination base (not including extra lamp-mount as the mount of the above lamp may be used)
Hand rests (for both hands)
Inclinable base for PM XVI

Catalogue No.	Code-word
30 01 20	Kybe
30 24 01	Kyco
30 31 51	Kybu
30 31 53	Kyca
30 41 11	Kyct
30 51 30	Kynx
30 51 37	Kynz
30 42 10	Kyao
30 50 50	Kyay
30 50 56	Kyol

For particulars please consult "CZ 30-171-2"



"Lanameter" for measuring the fineness of wool

Careful material testing has become a matter of course in every branch of industry and is generally considered to be the first as well as a most important of production processes.

Ever since their inception optical instruments have been used for testing and research purposes so that no up-to-date laboratory can do without them. Also the textile industry has availed itself of the greater dependability of optical inspection equipment over former means, adequate as the latter may have been in their time.

The degree of fineness of the wool is a significant factor in the subsequent processing as is the denier in artificial fibres, both requiring to be measured with exacting accuracy.

The "Lanameter" is a projecting type of measuring instrument designed for the aforementioned work and essentially operates on the principle of an inverted microscope. It projects upon a frosted screen an image of the fibre at a 500 times magnification. The frosted screen is rotatable and carries a cross scale graduated in half-millimetre intervals from which the reading may be taken. The bright illumination of the specimen makes it conveniently possible to operate the instrument in comparatively light rooms. As a light-source a 6V 15W low-voltage bulb is used which is operated via a transformer.

"Lanameter" comprising:

Desk-shaped housing with rotatable ground glass screen bearing a cross scale; illuminating device with iris and condenser including lamp mount with leads, fixed stage top with built-in fine adjustment microscope tube, reversing mirror adjustable calibration, laterally located controls for moving the specimen in two directions at right angles to each other, including a simplified special compound stage; Achromat 20/0.40, compensating eyepiece $\times 15$, 100 object slides (thickness 0.1 to 1.0 mm.)

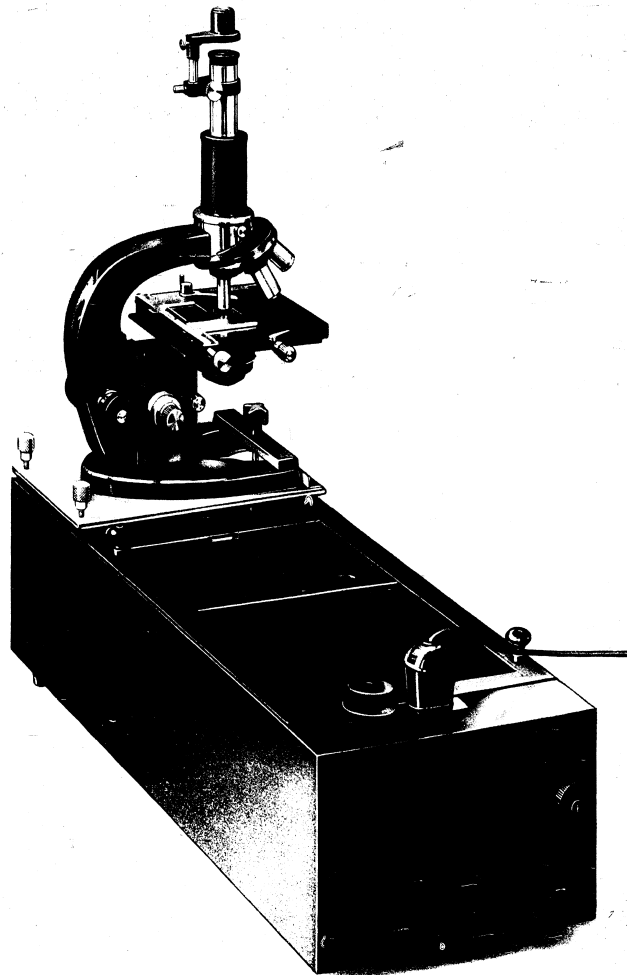
1 object slide carrier, 1 bottle immersion oil $n_D = 1.515 \pm 0.005$ at 20°C , not including projector bulb nor transformer (cf. p. 21).

Supplementary:

1 additional object slide carrier

Catalogue No.	Code-word
30 70 55	Kynsw
30 57 91	Kyoki

A special pamphlet is being prepared



Small type Micro-Projector

Excellent performance, simple manipulation, small dimensions and light weight are the outstanding features of this equipment. Owing to the high light intensity furnished by the arc-lamp the apparatus is available for projection in fairly large lecture rooms. The simplicity of its design enables lecturers to operate it themselves while lecturing.

The components of the illuminating device are housed in a metal case in a manner doing away with laborious adjustments. The microscope rests on a foot plate provided with an opening through which the light enters into the condenser of the microscope. A special type of collector-lens system with field stop permits the realisation of the Koehler principle of illumination. By means of two co-axially disposed control buttons the position of the carbons can be regulated by one hand, which considerably facilitates the manipulation in a darkened room.

Projection is effected by means of a prism mounted upon the microscope tube. When the "L"-type of stand is used a monocular straight tube is recommended in addition. Any type of microscope — unless equipped with integral illuminator — may be used together with the conventional objectives and eyepieces.

Connection of the apparatus to the mains is made through a resistance. The dimensions of the Micro-Projector are 57x23x22 cm., its total weight is about 11 kos.

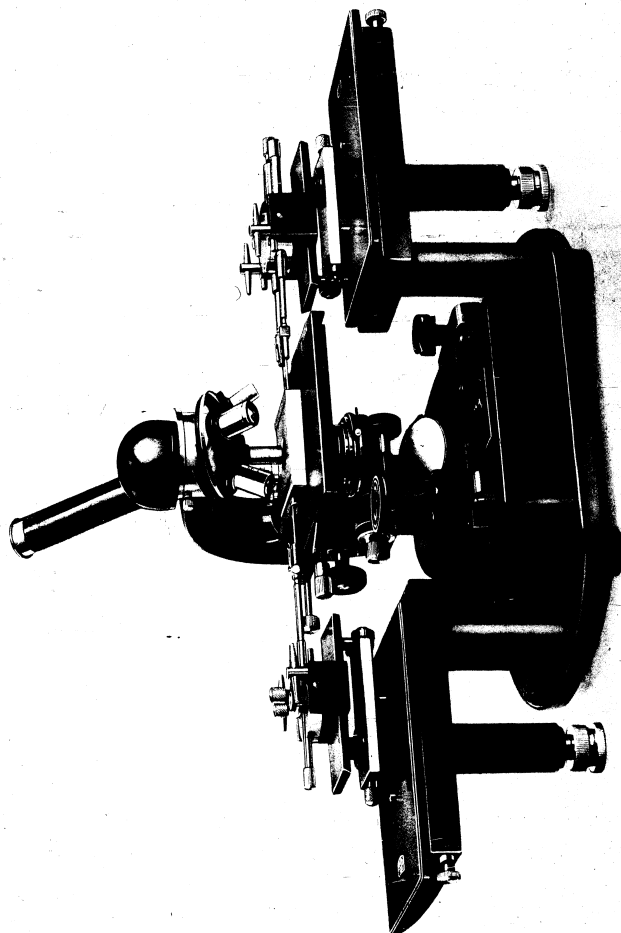
Small Micro-Projector

with hand-regulating arc-lamp for 6 A d. c. or 10 A a. c., collector, waterchamber, 45° inclined illuminating mirror in housing, with base plate for the microscope and instrument cable including resistance and 100 pairs of carbons for the arc-lamp (not including microscope).

Ready for connection to 6 A 220 V d. c.
Same for 10 A 220 V a. c.
and:
90° Projection prism

Catalogue No.	Code-word
307052	Kynvu
307052	Kyohf
305500	Kynuv

A special pamphlet is being prepared



Sliding Micromanipulator

This aggregate provides a means of accurately manipulating the very delicate instruments required in handling microscopic objects. It permits these instruments to be correctly held and operated at any magnification so that precise movements can be performed in any direction within the visual field of the microscope.

Micro-manipulating techniques have been considerably perfected as time went on and micrurgy, which was formerly restricted to biological objects, has been extended to the provinces of colloid chemistry, cellulose research, micro-chemistry and medicine. The extension of this branch of the microscopical dissecting and operating techniques has been accompanied by a corresponding perfection in micro-operating equipment.

The sliding principle has clearly proved superior to any of the conventional designs and affords a maximum of simplicity and reliability in handling. The arrangement of the controls is remarkably obvious. The Sliding Micromanipulator is so designed as to enable microscopists to operate it successfully within a very short time without undergoing any particular training.

Sliding Micromanipulator,

comprising two manipulating stands with vertical coarse and slow motions installed in the control handle, carrying plates for attaching needle holders, on base plate with registering stop and two clamps, in shipping case inclusive of 2 jars of grease (I and II), one wooden spatula, one glass plate, 2 single needle holders, each with two hose connections, 2 single needle holders, each with two needle clips, double needle holder on carrier, with two hose connections, and each with 2 hose connections and 4 needle clips.

Sliding Micromanipulator

equipped as above for our "Lp"-type of Microscope stands (not including the microscope)

Same, including adapter plate for "Lg"-type of stands (not including microscope)

Same, including adapter plate for "Lu"-type of stands (not including microscope)

Supplementaries:

Monocular, image-erecting inclined tube "L"

Dissecting bright-field/dark-ground change-over condenser N.A. 0.5 for "Lg" and "Lu" stands

Moist chamber, including 1 set of connection sleeves and 100 cover slips 24 x 24 mm.

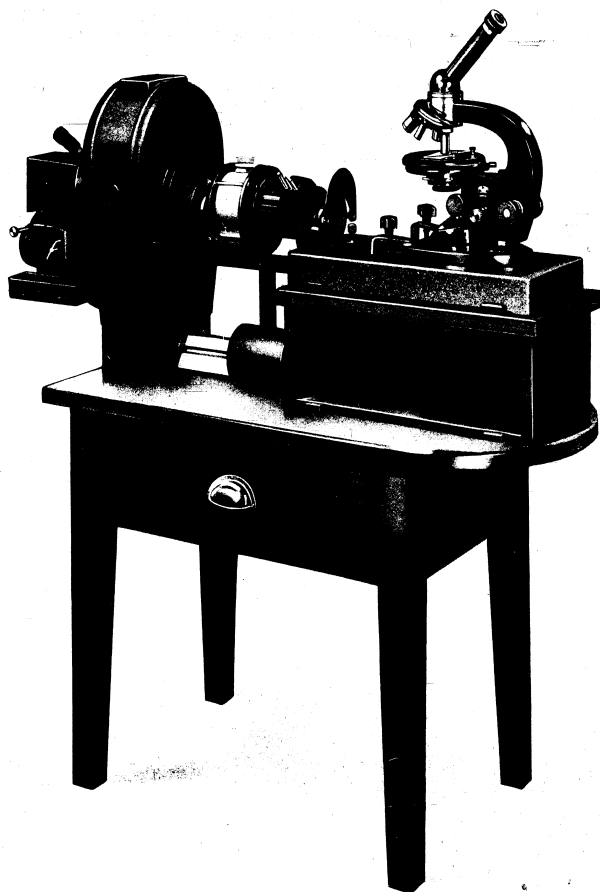
Required for attachment of moist chamber to "G"-stages: Adapter for moist chamber and "G"-stage

Attachable mechanical stage with adjustable object holders for attaching the moist chamber (not required for "E" and "G"-stages)

Micro-burner with 2 different I. D. hollow needles

Catalogue No.	Code-word
30 58 30	Kyltu
30 58 31	Kylxy
30 58 32	Kylzy
30 50 24	Hylza
30 43 15	Hymaa
30 58 14	Hymbb
30 58 23	Kyqjh
30 51 10	Kudty
30 58 21	Kymcc

For particulars please consult "CZ 30-500-1"



Large Luminescence Equipment

This equipment is available for routine examinations and in the research of primary and secondary fluorescence-phenomena as stimulated in blue light or in the near ultra-violet. Observation will be possible both by the transmitted as well as by the incident light method.

Since its advent about forty years ago, Fluorescent Light Microscopy has gained a firm foothold in many fields, particularly in the medico-biological branches, where some of the luminescence methods have become an indispensable accessory in scientific research. This includes, for instance, the Strugger intra vitam fluorescent dye staining method with acridine orange permitting the discrimination of living and dead cells, and the Hagemann method of staining tubercle bacilli with auramine, which affords a reliable and time-saving means of diagnosing tuberculosis, and furthermore, the microscopic detection by fluorescence indicators, of pH-modifications in plant and animal tissues. Besides these fluorescent light microscopy is widely resorted to in histological, physiological and chemical investigations, as well as in the provinces of forensic medicine, food-stuff examinations and for technological purposes.

Beyond fluorescent light microscopy our major type of luminescence equipment is recommended also for photomicrographic and micro-projection purposes as well as for any microscopic work requiring a very intensive source of light covering either the whole of the spectrum or certain regions of it.

Any conventional type of microscope may be used as long as a vertically adjustable Abbe sub-stage is provided for. As the light produced in the specimens is of the visible spectrum it will be possible to use the normal type of objectives and eyepieces for observation purposes.

Large Luminescence Equipment (Basic Equipment) consisting of:

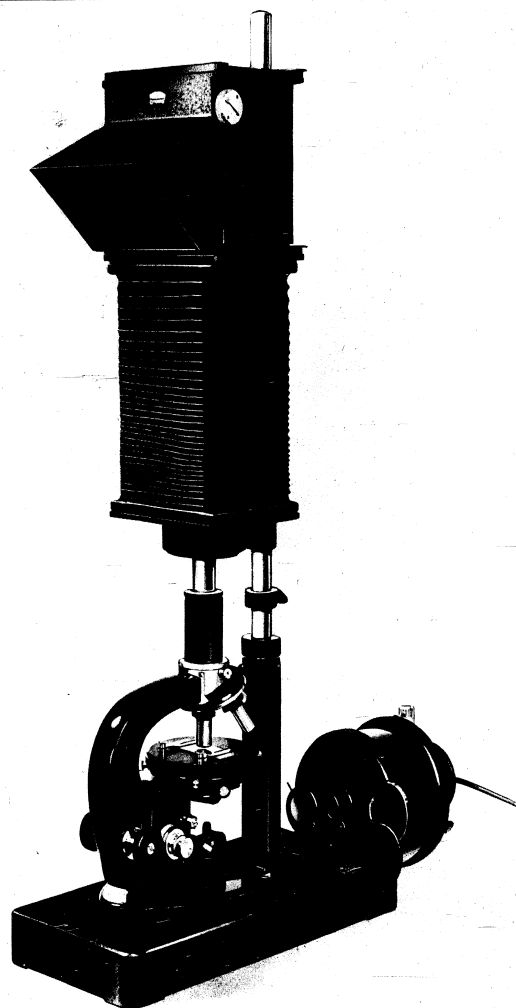
Table with drawer and folding top, including wooden support and rail for optical bench, illuminator on saddle stand, two-component collector with iris diaphragm, cooling cell, filter system with 4 swing-out holders for 55 mm. filters, light-shield, 2 blue filters BG 3, 2-Uvett filters UG 1, base plate, Uran-glass plate 32 mm. with annular mark, neutral filter NG 10, eyepiece check filters GG 9 and OG 1 in slip-on mounts, including clockwork feed arc-lamp with observation mirror, resistance and 100 pairs of carbons for arc-lamp.

Basic Equipment, including electrical accessories for 220V. a. c. (not including microscope)

Basic Equipment, including electrical accessories for 220V. d. c. (not including microscope)

Catalogue No.	Code-word
30 04 00	Kyhjo
30 04 01	Kyhms

For particulars please consult "CZ 30-541a-1"



"ST" Vertical Camera

Simple and rapid operation, remarkable versatility and maximum performance in the various fields of photo-micro- and photo-macrography are the salient features of this instrument. A facility of special importance is the fact that by simply changing the bellows extension it will be possible to vary the imaging-scale without necessitating an interchange of whatever optics might happen to be in the instrument at the moment. As the camera and the microscope are separate units users will be free to use any microscope suitable for photo-micrographic purposes and to increase the range of applicability by the addition of further supplementaries.

"St" Vertical Camera 9x12 cm. with illuminating device

consisting of:

Base plate with column, extensible swing-out camera 9x12 cm., 2 metal plate holders, one each frosted and clear glass screen, light-screening sleeve and light-trap, lamp housing with filter holder for 32 mm. fitting, light-flap, x 6 focusing magnifier, neutral glass filter and reflector attachment (not including microscope nor electrical accessories)

Accessories:

Trichrome filters (1 yellow and 1 blue, 32 mm. diameter)
Monocular straight tube connecting camera and microscope
(required only for Zeiss "L"-type microscopes)

For Macro-work:

With focusing mount for objectives with iris diaphragm screwing to camera front panel
Tessor F 4.5 f=135 mm., T-optics, in special mount

Microtars: Please apply for particulars

Recommendable accessories:

Multiplicator for ascertaining proper exposure period (for 9x12 cm. size)

Electrical accessories:

12V 100W projection bulb
Transformer 220/12V 100W including leads

Catalogue No.	Code-word
30 60 60	Kwya
30 46 45	Pjang
30 50 04	Hobac
30 86 40	Pena
54 06 01	Hwahl
30 86 65	Kygor
2544ZN54	Petru
05 85 30	Pekxo



Microscope Lamps

Effective illumination is an indispensable factor in microscope examinations. For exacting requirements we now offer the new "D" and "E" lamps which represent advanced designs of our wellknown series of low-voltage lamps. They permit of the perfect realisation of the Koehler principle and are particularly recommended for phase-contrast and dark-ground as well as for photomicrographic work.

Both of the new models are equipped with heat-diverting ruby-glass cylinders. An optimal yield of light and uniform illumination of the visual field is obtained by a non-spherical collector lens of high aperture and excellent quality. The equipment is completed by swing-out filter holders for the usual type of filters 32 mm. in diameter, as well as for a stain-frosted blue filter inserting between light-source and collector.

Model "D" which is fitted with ball and socket joint is specially well adapted for work in transmitted light. Model "E" is provided with upright column for adjustment in height and tilt and also, therefore, conveniently available for incident-light work. By means of connecting bars a rigid alignment is brought about between the lamp and the microscope. Both models of lamps are fitted with 6V. 15W. low-voltage lamps connecting to mains via a resistance.

Model "C" is recommended for bright-field observation, as, e.g., in class work and is equipped with a tubular lamp 220V 25W for direct connection to the mains.

Microscope lamp D, consisting of:
housing with ruby-glass cylinder, non-spherical collector, iris diaphragm 33 mm. with dual holder for colour filters, with ball and socket joint on pear-shaped foot, including blue filter as well as lamp mount: with cord (not including projector bulb nor transformer)

Microscope Lamp E (cf. illustration, top):
Same as above, but on pillar with pear-shaped foot including lock
with starshaped handle
Connecting bar

Electrical accessories
(also required for: "Lumipan" p. 13, "Lanameter" p. 31, Stereo-Microscopes pp. 33-35, Incident Light Condenser p. 37, and "Epignost" p. 39)

Projector bulb 6V 15W clear glass
Projector bulb 6V 15W frosted (for photo-micrography)
Transformer 220/15V 15W including leads

Microscope lamp C (cf. illustration, bottom)
on pear-shaped foot, including connecting bar, inclinable housing,
blue filter and mains connection (not including bulb)
Tubular lamp 110V 25W
Tubular lamp 220V 25W

Catalogue No.	Code-word
30 42 C3	<i>Kynsr</i>
30 42 04	<i>Kynts</i>
30 42 35	<i>Kynct</i>
2613ZN54	<i>Kwoim</i>
2613ZNS4ksm	<i>Kwoko</i>
C5 85 26	<i>Kwon3</i>
30 42 C2	<i>Kybyi</i>
1211ZN54	<i>Kyboa</i>
1216ZN54	<i>Kyomy</i>

A special pamphlet is being prepared



Microscope accessories

Simplified attachable mechanical stage (75 x 25 mm. movement) ungraduated

For Dark-Ground Observations:

Cardioid Dark-Ground Condenser 1.05 with centering device, in case

Microscope Lamps for above (see page 21)

Tube attachments:

Binocular inclined body tube "Bitukni L", "T"-coated, primary magnification 1.5 X
Monocular inclined tube "L"
Monocular inclined tube "L", extensible with millimetre-scale
Monocular straight tube, (required for photomicrography and polarisation with "L"-microscopes)
Monocular straight tube, extensible with millimetre-scale

For Polarisation:

Filter Polariser On "lg"-stands only to be used with the monocular straight tube
Filter Analyser
Compensator Red 1
Compensator $\frac{1}{2}$ 2

Catalogue No.	Code-word
30 51 10	<i>Kudly</i>
30 43 10	<i>Kavuc</i>
30 50 00	<i>Knyyc</i>
30 50 01	<i>Knywa</i>
30 50 02	<i>Ksome</i>
30 50 04	<i>Kobac</i>
30 50 05	<i>Ksori</i>
30 59 00	<i>Kimoz</i>
30 59 10	<i>Kimpa</i>
30 59 70	<i>Kimue</i>
30 59 76	<i>Kinku</i>

Objectives for Microscopes

Optical Systems	Image Scale	N.A.	Focal Length mm.	Free Working Distance mm.	Catalogue No.	Code-word
Achromatic Objectives						
Dry Series	3	0.20	36	29	30 20 02	<i>Kohtb</i>
	8	0.30	18	9	30 20 05	<i>Kohtok</i>
	10	0.30	15.3	7.0	30 20 06	<i>Kohtol</i>
	20	0.40	8.3	1.6	30 20 07	<i>Kohtm</i>
Homogeneous Oil Immersion Series	40	0.65	4.4	0.55	30 20 08	<i>Kohto</i>
	90	1.25	2.0	0.11	30 20 14	<i>Koini</i>
	90 ¹⁾	1.25	2.0	0.16	30 20 15	<i>Koin</i>
Apochromatic Objectives						
(Only for use in combination with compensating eyepieces)						
Dry Series	10	0.30	16.2	5	30 20 51	<i>Kogun</i>
	20	0.65	8.3	0.7	30 20 52	<i>Kogvo</i>
	40	0.95	4.3	0.12	30 20 53	<i>Kokat</i>
	40	0.95	4.3	0.12	30 23 43	<i>Ktywf</i>
Homogeneous Oil Immersion Series	60 ¹⁾	1.00	2.9	0.22	30 20 57	<i>Kokha</i>
	60	1.40	2.9	0.13	30 20 59	<i>Kokie</i>
	90	1.30	2	0.11	30 20 60	<i>Kohoh</i>

¹⁾ Special type objectives for dark-ground observation. (May also be used for bright-field work)



Eyepieces for Microscopes

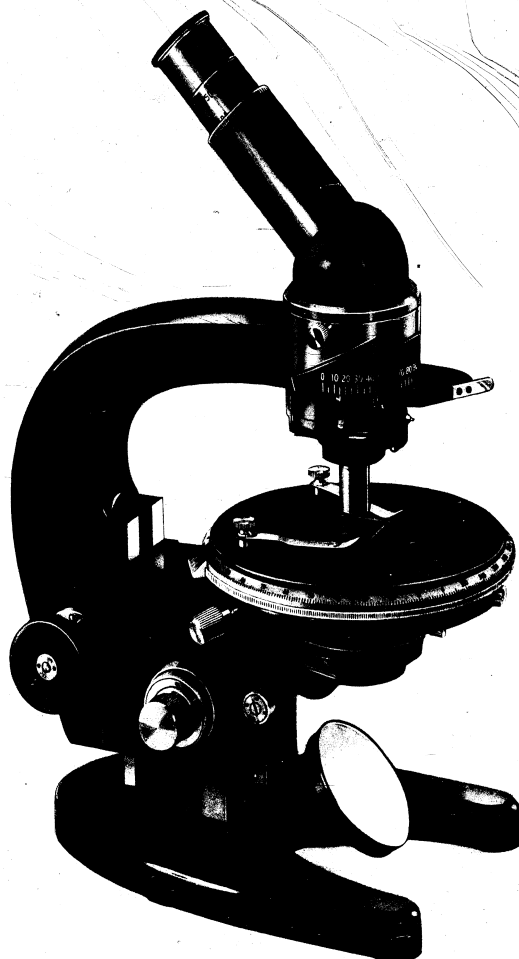
(Diameter of Mount 23.2 mm.)

Notation = Factorial magnification	Focal Length mm.	Field of view number	Catalogue No.	Code-word
Huygenian Eyepieces				
(for low and medium power Achromats)				
x 5	50	23	30 31 01	<i>Komdu</i>
x 7	36	18	30 31 02	<i>Komev</i>
x 10	25	14	30 31 03	<i>Knurz</i>
Orthoscopic Eyepieces				
(for low and medium power Achromats)				
x 12.5	20	16	30 31 10	<i>Komiz</i>
x 17	15	13	30 31 11	<i>Komja</i>
Compensating Eyepieces				
(for all Achromats and high-power Achromats)				
K x 5	50	23	30 31 20	<i>Komsi</i>
K x 7	36	18	30 31 21	<i>Komuk</i>
K x 10	25	13	30 31 22	<i>Komyo</i>
K x 15	17	11	30 31 23	<i>Konap</i>
K x 20	12.5	8	30 31 24	<i>Konbr</i>
K x 30	8.4	5.7	30 31 25	<i>Koncs</i>

Micrometer Eyepieces and Accessories

Adjustable eyepiece H x 7 (without micrometer)
Adjustable eyepiece K x 7 (without micrometer)
Adjustable eyepiece O x 12.5 (without micrometer)
Adjustable eyepiece O x 17 (without micrometer)
Eyepiece micrometer 5 mm. divided into 100 parts ($1/_{100}$)
Eyepiece micrometer 10 mm. divided into 100 parts ($1/_{100}$)
Squared Eyepiece Micrometer 10 mm. in case
Object micrometer 1 mm. divided into 100 parts
Eyepiece screw micrometer with x 15 compensating eyepiece in case
Cross line disc (in box) for insertion into adjustable eyepieces
For Demonstration Purposes:
Pointer Eyepiece H x 10

30 31 05	<i>Kozei</i>
30 31 26	<i>Kozko</i>
30 31 13	<i>Hegob</i>
30 31 14	<i>Kozim</i>
30 57 10	<i>Kradl</i>
30 57 11	<i>Kraej</i>
30 57 14	<i>Krawb</i>
30 57 20	<i>Krams</i>
30 57 31	<i>Krajo</i>
30 57 16	<i>Kroar</i>
30 32 01	<i>Krobs</i>



Polarisation Equipment for "L"-Stands

Microscopic observation in polarised light plays an important part in the various branches of natural science. Besides animal and vegetable tissues numerous products and raw materials of the glass and ceramic industries as well as products of crystalline reactions and thin mineralogical sections represent suitable objects for examination in polarised light. The knowledge of anisotropic optical properties makes it possible to draw important conclusions pertaining to the structure of the objects under investigation.

The polarising filters, which are nowadays successfully employed in place of calcite polarisers, have been improved to an extent resulting in practical extinction when crossed.

Our "L"-type of stands will be provided with two kinds of filter-polariser equipments. The ordinary equipment consists of an analyser attachable to the eyepiece, of compensators and of a polariser which is inserted into the filter holder of the substage. For this assembly a straight monocular tube is required.

The second equipment comprises a special type of slide fitting with filter analyser (cf. illustration) which attaches to the microscope in place of the revolving nosepiece slide-type of objective changer. A monocular inclined draw tube is provided for observation comfort. The analyser is of the swing-out type, rotatable about 90°. The degree of rotation is indicated by a scale. The compensators insert beneath the analyser. The polariser is placed into the filter holder, same as in the ordinary equipment. For the Zeiss "Lumipan" microscope a special make of polariser is supplied slipping onto the lower end of the parafocal system. The objectives are being attached by means of a centering type of slide fitting. For measuring the angular positions a rotatable object stage "B" with graduation and vernier is recommended (cf. illustration).

Recommended Assembly:

Stand "Lg" with quick-changing device for tubes. Rack and pinion adjustable substage O, simplified rotatable mechanical stage B, with graduation and vernier, in cabinet with lock and key.

including

Monocular inclined tube L, extensible with mm-scale
Condenser 1.2 with iris diaphragm and filter holder
Slide fitting with filter analyser
Compensators Red 1st order and $\frac{1}{4}\lambda$
4-Objective-slides with centering device

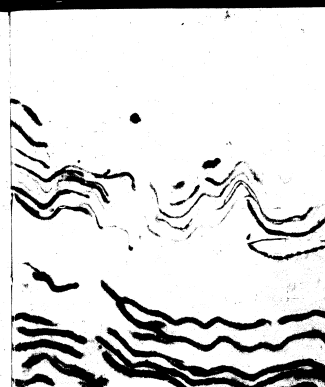
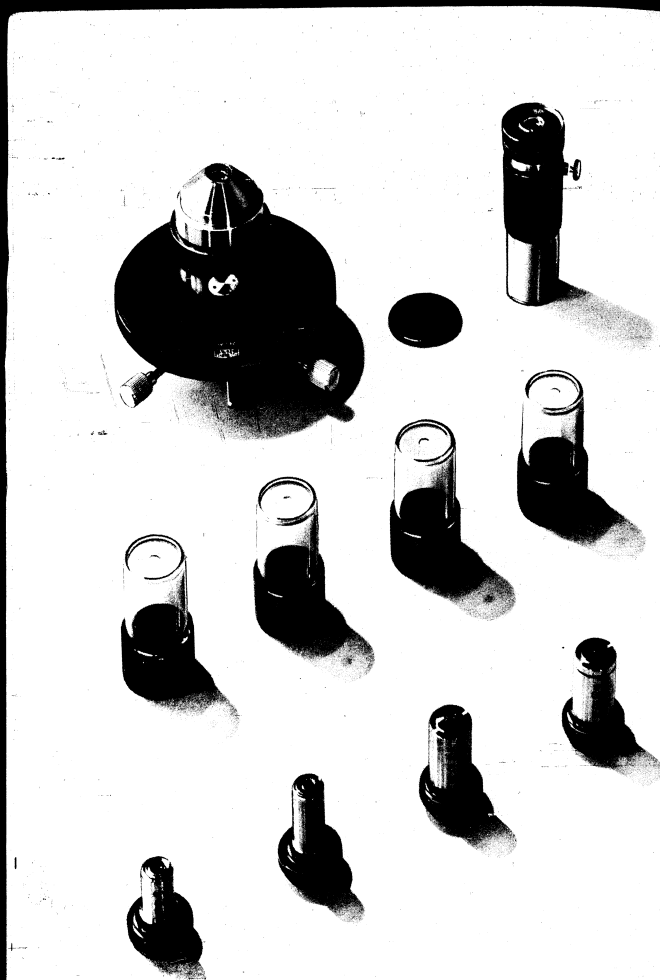
Filter polariser
Achromats 3, 8/0, 20, 20/0, 40, 40/0.65
Huyghenian Eyepieces x 5 and x 10
Huyghenian Eyepiece x 7, focusable
with crosshairs

Monocular Microscope LgOB (Pol)

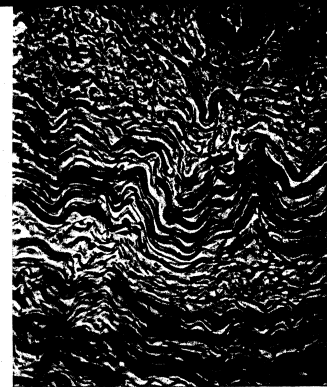
equipped as above,
for magnifications from x 15 to x 400
Simplified filter polarising equipment cf. p. 18

Catalogue No.	Code-word
30 00 23	Kynnp

A special pamphlet is being prepared



Bright field
Longitudinal Section of Human Peripheral Nerve (in connective tissue degeneration).



Phase contrast

Phase Contrast Equipment

The phase contrast method offers valuable assistance to science in general and to biological and diagnostic research in particular where the observation of microscopical processes is concerned. This applies especially to unstained living objects which can now be observed and photographed with a distinctness unattainable in the past. The special type of objectives designed for phase contrast work are also available for the conventional microscopic observation of stained specimens in bright field and dark ground illumination. The Achromat Ph 90/1.25, homogeneous oil immersion can be used for bright-field work only.

Components:

Achromatic Objective Ph 10/0.30
Achromatic Objective Ph 20/0.40
Achromatic Objective Ph 40/0.65
Achromatic Objective Ph 90/1.25 (homog. oil immersion)
Yellow/Green Filter
Phase condenser with auxiliary microscope in case (for the conventional types of microscopes)
Annular diaphragm in mount and auxiliary microscope (for "Lumipan")

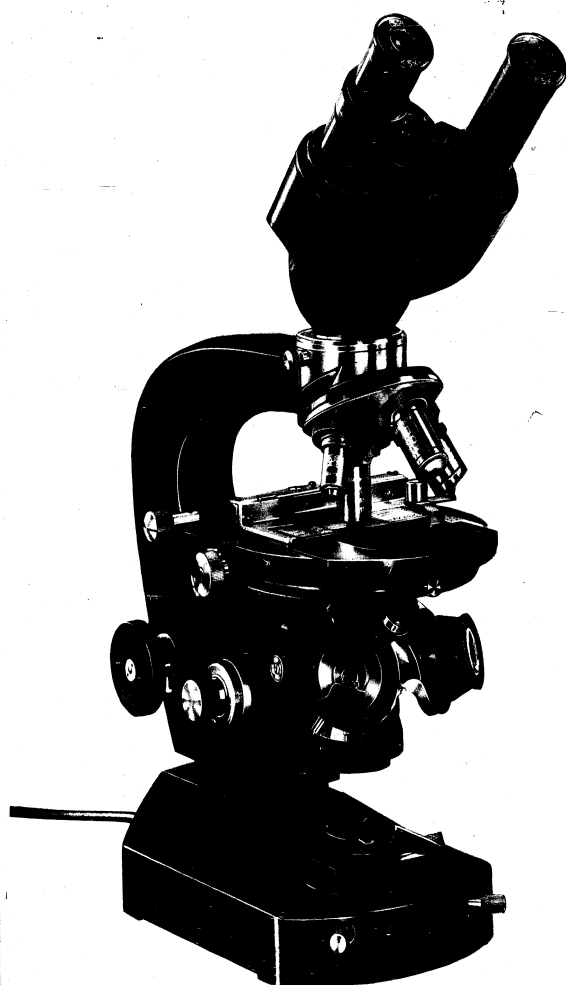
Phase Contrast Equipment for the conventional type of microscopes¹⁾
consisting of: Phase condenser and auxiliary microscope, Yellow/Green Filter and four phase contrast objectives (as above)

Phase Contrast Equipment for "Lumipan" Microscope
consisting of: Annular Diaphragm in mount and auxiliary microscope, Yellow/Green Filter and four phase contrast objectives (as above)

Catalogue No.	Code-word
30 20 83	<i>Rusuk</i>
30 20 80	<i>Kusya</i>
30 20 81	<i>Kutap</i>
30 20 82	<i>Kuteu</i>
30 46 26	<i>Plapi</i>
30 43 40	<i>Kutae</i>
30 40 27	<i>Kutka</i>
30 43 41	<i>Hyhej</i>
30 43 42	<i>Hyhin</i>

¹⁾ The phase contrast equipment is adaptable to any make of microscope provided the diameter of the condenser sliding sleeve is not smaller than 36.8 mm. and that there is sufficient space for the revolving disc of the phase condenser (diameter 96 mm.).

For particulars please consult Pamphlet CZ 30-304-a-2



Research Microscope "Lumipan"

The integral illuminating system installed in the base and the pancratic system of the substage are the outstanding features of this instrument. They are both provided with "T"-coated optics.

The illuminating system and the microscope form one single unit without unduly increasing the height of the "Lumipan" as compared with the height of the standard type of Zeiss "L" stands.

The brightness achieved by the illuminating system is adequate even for difficult microscopic and photomicrographic work. By means of the pancratic system the aperture of the aplanatic condenser may be continuously changed from 0.16 to 1.40. Above the pancratic system a triple condenser turret is arranged carrying a spectacle-lens condenser, an aplanatic condenser and a dark-ground condenser. The changing of condensers with the aid of the revolving nosepiece offers considerable advantages over the former conventional method of changing them in sliding sleeves.

The "Lumipan" is available for binocular or monocular work in ordinary or polarised light, using either the bright-field or dark-ground. The microscope is particularly recommended for phase contrast observation.

Recommendable Equipment:

Stand „Lp" with quick-change device for tubes. Substage with pancratic system, triple condenser turret, with spectacle-lens condenser for low aperture objectives, aplanatic condenser 1.4 for objectives with apertures from 0.16 to 1.40 and Cardoid-condenser for dark-ground illumination, large mechanical stage E (range of movement 75 mm. x 50 mm.) in cabinet with lock and key (without transformer and projector bulb, cf. page 21).

Including:

Monocular inclined tube L
Binocular inclined body tube "Bitukni L"
with "T"-optics, primary magnification 1.5 x
Quadruple revolving nosepiece on dovetail slide
Compensating paired eyepieces 5 x, 7 x and 10 x
Compensating eyepiece 15 x

Apochromats 10/0.30 and 20/0.65
Apochromat 60/1.00, homogeneous oil immersion with iris diaphragm for dark-ground observation (also for bright-field observation)
Apochromat 90/1.30, homogeneous oil immersion for bright-field observation

Binocular Microscope LpE "Lumipan"

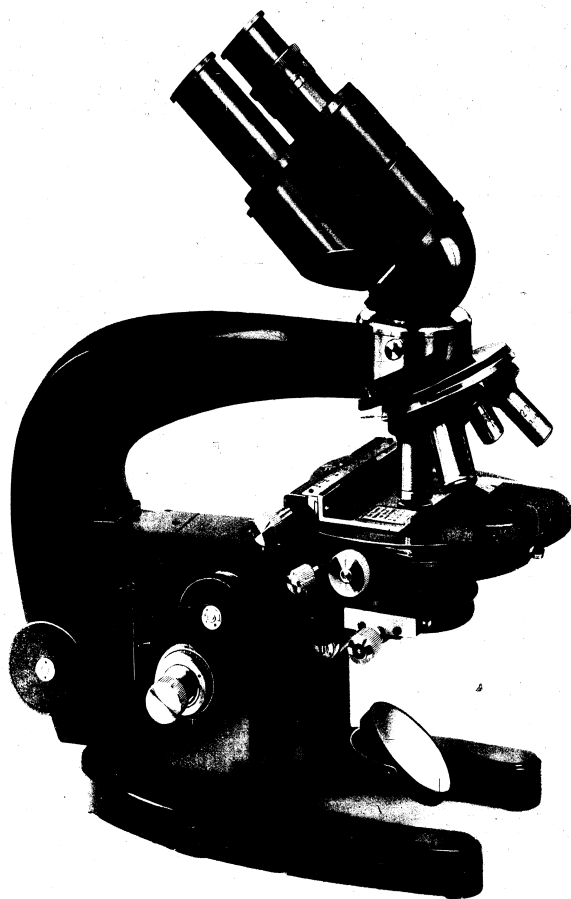
equipped as above for magnifications from x 50 to x 1350

Binocular Microscope LpG "Lumipan"

same as "Ksiht" but with square mechanical stage G (range of movements 75 mm. x 50 mm.) in place of the large mechanical stage E

Catalogue No.	Code-word
30 00 40	Ksiht
30 00 41	Hycju

For particulars please consult Pamphlet CZ 30-126-a-2



Large Universal Microscope "LuWdE"

The constructional arrangement of the "Lu" type renders it excellently available as a Universal stand for subjective and photomicrographic work in transmitted same as in incident light. The stage with its support and the substage with the motion box are detachable. With the substage removed the stage can be vertically adjusted thus specially adapting the stand for surface observations, as well as for the microscopical examination of ore and petrographic examinations with particular respect to coal. The instrument is well suited for observing high objects also.

The low-positioned controls for the condenser, coarse and fine focusing adjustments as well as the monocular and binocular inclined tubes make for a maximum of observation comfort. The "LuWdE" model is equipped with the full Abbe substage.

The Filter Polarising Equipments referred to on page 17 may be used with this model and, in conjunction with the relevant optics, make the instrument available for observations in transmitted polarised light.

In the illustration the "LuWdE" model is shown equipped for examinations in transmitted light. For work in incident light the assembly shown on page 37 is recommended.

Recommendable Assembly:

Stand "Lu" with quick-change device for tubes, interchangeable motion box with illuminating mirror and Abbe substage Wd with diaphragm carrier and laterally adjustable and rotatable iris diaphragm, interchangeable and vertically adjustable stage support with large mechanical stage E (range of movements 75 mm. x 50 mm.) in cabinet with lock and key.

Including:

Binocular inclined body tube "Bitukni L" with "T"-optics, primary magnification 1.5 x
Condenser 1.2
Quadruple revolving nosepiece on dovetail slide
Achromats 8/0.20, 20/0.40

Achromat 40/0.65
Achromat 90/1.25, homogeneous oil immersion with iris diaphragm for bright-field and dark-ground observation
Huygenian paired eyepieces 5 x, 7 x, and 10 x

Binocular Microscope LuWdE

equipped as above
for magnifications from x 60 to x 1350

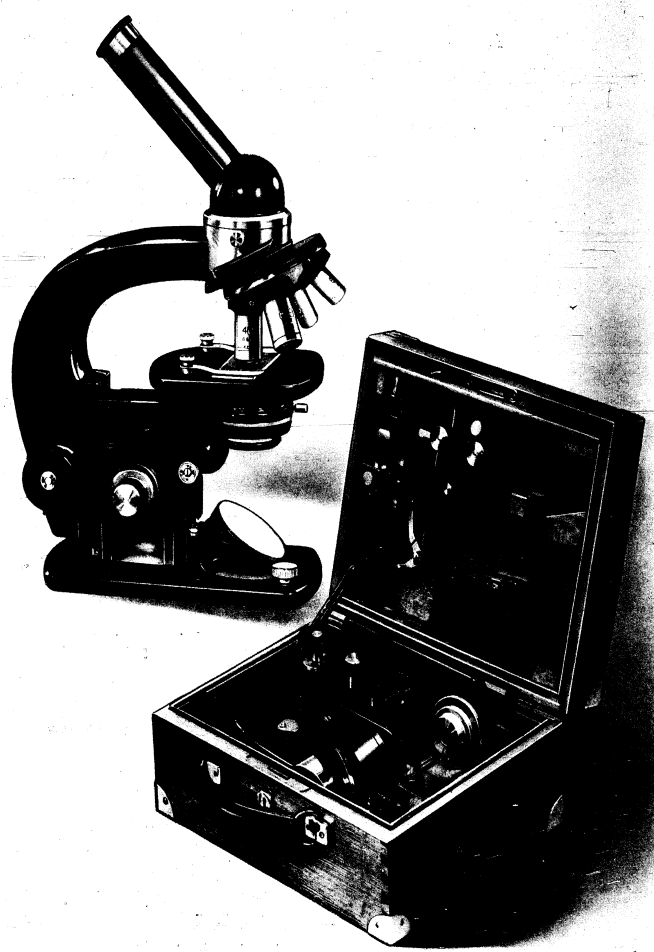
Binocular Microscope LuWdG

same as "Kyaer", but with square mechanical stage G (range of movements 75 mm. x 50 mm.) in place of the large mechanical stage E

Catalogue No.	Code-word
30 00 32	Kyaer
30 00 33	Kyals

A special pamphlet is being prepared

0075.7



Travelling Microscope "LrO"

This microscope is designed on the same lines as the other "Lg" models described herein. Departing merely in the shape of its foot and in being provided with a special type of stage the Travelling Microscope combines all the advantages of low-positioned coarse and fine adjustments and inclined tube, with low weight and small dimensions. Equipped with our standard supplementaries it represents at the same time an efficient laboratory type of microscope.

As the stage and base are permanently connected with the stand it will merely be necessary to attach the tube for the microscope to be ready for work.

The substage can be used in conjunction with any of the listed condensers including the phase condenser as well as the dark-ground condenser. The quadruple revolving nosepiece carries as a standard equipment the Achromats 8/0.20, 40/0.65 and 90/1.25, the last being available as an oil immersion objective with iris diaphragm for bright-field and dark-ground observations. Objectives may remain in the revolving nosepiece during transport. For a fourth objective space is reserved within the cabinet.

The well-sealed cabinet is easily portable and is made of teak, measuring 27.5 x 22 x 13 cm., weight about 6 kos.

Recommendable Assembly:

Stand "Lr" with quick-change device for tubes. Rack and pinion adjustable substage O, fixed square stage, including 10 object slides, 100 cover slips, bottle for immersion oil in metal container and container for vaseline, in portable cabinet with lock and key.

Including:

Monocular inclined tube L
Condenser 1.2 with iris diaphragm and filter holder
Quadruple revolving nosepiece on dovetail slide
Achromats 8/0.20 and 40/0.65

Achromat 90/1.25, homogeneous oil immersion with iris diaphragm for bright-field and dark-ground observation
Huygenian Eyepieces 5 x and 10 x

Monocular Travelling Microscope "LrO"

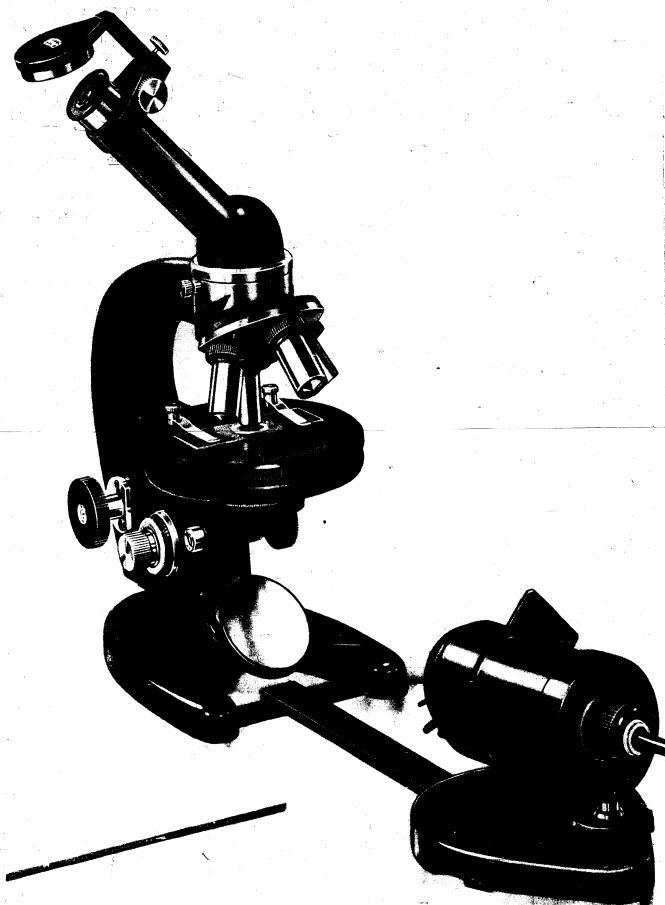
equipment same as above
for magnifications from 40 x to 900 x

Supplementaries:

Simplified Attachable Mechanical Stage, range of movement 75 mm. x 25 mm., without graduation
Dissecting Utensils, straight scissors, straight forceps, scalpel, dissecting needle with metal handle, in leather case and Cornett forceps

Catalogue No.	Code-word
30 00 15	Kymgg
30 51 10	Kudty
30 58 20	Kymhh

Accommodation is provided for in the microscope case for the dissecting utensils, one mechanical stage and the Cornett forceps.



Medium-size Microscope "LgOH"

Model "LgOH" as shown at the left is equipped with the new type of sliding stage "H" which — basing on the same principle of movement employed in our Sliding Micromanipulator — is specially well adapted for following movable objects as well as for measuring work with ocular micro-meters and for the exploration of specimens.

The sliding stage is conveniently actuated by hand without recourse to any other mechanical means. Its displacements may be effected in any optional direction thus obviating the necessity of operating two different spindles as in the case of the mechanical stage. The new stage permits of minutest displacements of specimens to be made with great accuracy and up to the highest magnifications without thereby affecting the fine adjustment.

There are two models of sliding stage "H" for our L-type of stands, one for permanent attachment to the stage support, same as our "C" and "G"-stages, while the other is inserted into the centering piece of the "B" and "E"-stages and may be interchanged for the latter.

The illustration furthermore displays a newly designed drawing mirror which, if attached to inclined tubes, permits the graphical tracing of the image of microscope objects as projected upon the table.

Recommendable Assembly:

Stand Lg with quick-changing device for tubes. Rack and pinion adjustable substage O, Sliding stage H, in cabinet with lock and key.

Monocular inclined tube L
Condenser 1.2 with iris diaphragm and colour glass holder
Quadruple revolving nosepiece on dovetail slide
Achromats 8/0.20 and 40/0.65

Achromat 90/1.25, homogeneous oil immersion for bright field observations
Huygenian eyepieces x7 and x10
Compensating eyepiece x15

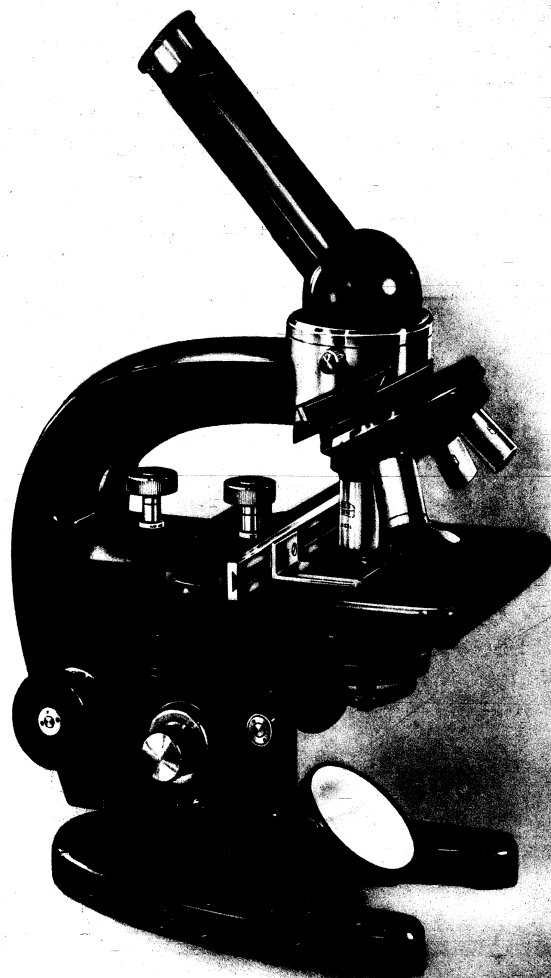
Monocular Microscope "LgOH"

equipped as above
for magnifications from x56 to x1350

Supplementaries:

Projection Drawing Mirror,
and Microscope lamps as shown on p. 21

Catalogue No.	Code-word
30 00 20	Kynon
30 55 01	Kynpo



Medium-size Microscope "LgOC"

The "Lg"-type represents a routine class of microscope for any scientific and technological laboratory, as well as for physicians and naturalists.

In the illustration model "LgOC" is shown as a specimen belonging to that class.

The instrument is equipped with a simplified, vertically adjustable substage. The fixed square stage is arranged to take a simplified attachable mechanical stage, as shown in the illustration. As all our "Lg"-models, it may be subsequently equipped for a variety of purposes. Observation is either monocular or binocular, the change of tube attachments being easily and rapidly effected by a quick-change device.

The "Lg" type may be equipped with a variety of object stages. For particulars please consult pamphlet "CZ 30-038-2" which will be gladly supplied upon request.

Recommendable Assembly:

Stand "Lg" with quick-change device for tubes. Rack and pinion adjustable substage O, fixed square stage C, in cabinet with lock and key.

including:

Monocular inclined tube L,
Condenser 1.2 with iris diaphragm and colour filter
Quadruple revolving nosepiece on dovetail slide
Achromats 8/0.20 and 40/0.65

Achromat 50/1.25 homogeneous oil immersion
for bright field observation
Huygenian eyepieces $\times 7$ and $\times 10$
Compensating eyepiece $\times 15$

Monocular Microscope "LgOC"

equipped as above
for magnifications from $\times 56$ to 1350

Catalogue No.	Code-word
30 00 11	Hymu

For accessories for binocular observation and further supplementaries please consult pages 18 & 19

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Foreword

After a considerable lapse of time we have now the pleasure of satisfying the numerous requests for a brief review over our present manufacturing programme.

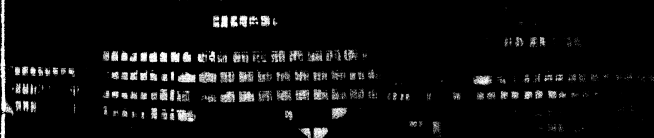
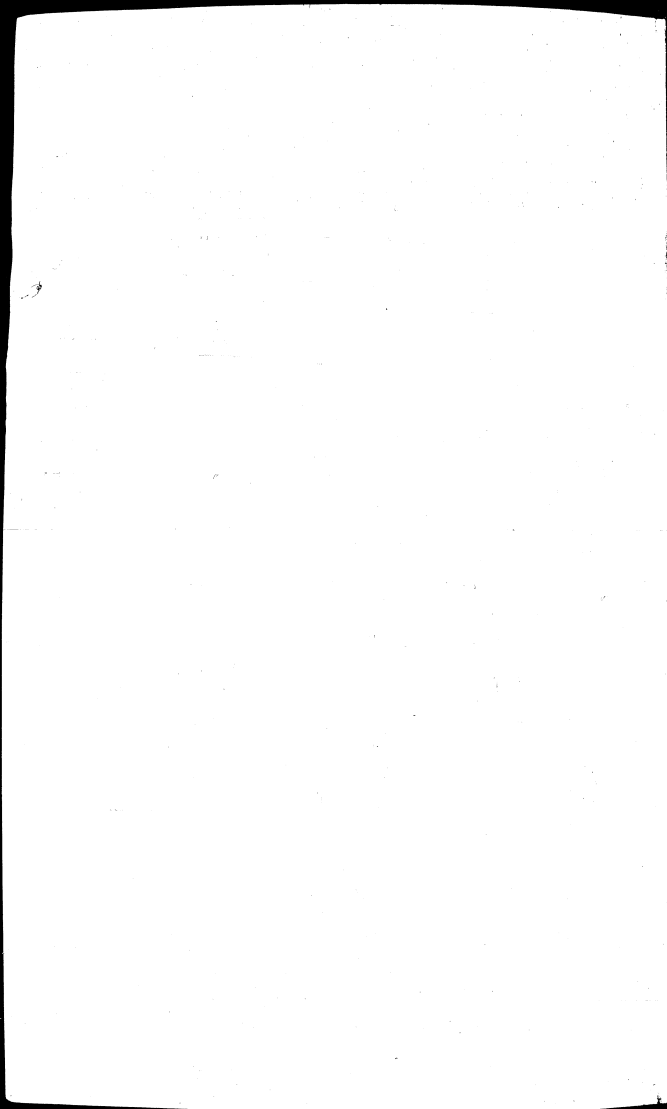
Besides those known types which have stood the test of time we are in a position to present to our friends a selection of new instruments produced in perfect collaboration with an experienced staff of scientists, engineers and specialists.

The most appreciative reception accorded to the new designs wherever tested in practical work is a source of satisfaction to us, and affirms that we are continuing on the right road towards setting an example in the opto-scientific province and justifying the worldwide confidence placed in the name of Zeiss as a symbol of

QUALITY AND ADVANCEMENT.

Jena, Spring 1952

OPTIK
CARL ZEISS JENA VEB
 Dept. Microscopy



THE TRADITIONAL CENTRE
FOR OPTICAL RESEARCH
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Mikroskope
Mikrophotographische Geräte
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Lumineszenzeinrichtung
Zusatzgeräte für Mikroskopie

Kalposkope
Operationsmikroskop
Ohrlupe
Beleuchtungseinrichtungen für Operationsstühle
Mundleuchte

Geräte zur Untersuchung der Augen
Geräte zur Bestimmung und Prüfung von Brillen
Lupen

Refraktometer
Laboratoriums-Interferometer
Handspektroskope
Spiegelmonochromator
UV-Spektrograph Q 24
Lichtelektrische Photometer
Pulfrich-Photometer
Polarimeter
Konimeter
Abbe-Komparator
Skalengalvanometer

Mechanische Geräte für Längen-
und Gewindemessungen
Zahnradprüfgeräte
Optisch-mechanische Geräte für Längen-,
Gewinde- und Profilmessungen
Geräte für Winkel-, Teilungs-
und Fluchtungsprüfungen
Profilprojektoren
Interferenzkomparator
Endmaße

Nivelliere
Theodolite

Reduktions-Tachymeter
Zusatzgeräte

Photographische Objektive
Kino-Aufnahme- und Projektions-Objektive
Reproduktions-Optik
Prismenvorsätze für Stereoaufnahmen

Tonkino-Koffer-Anlagen 35 mm und 16 mm
Stummfilmkoffer 16 mm
Kinospiegel
Epidioskope
Kleinbildwerfer
Röntgendiaskop
Röntgenschirmbildkameras
Aufnahme- und Lesegeräte für Dokumentation
Schreibprojektor

Feldstecher
Theatergläser
Zielfernrohre

Refraktoren
Astrographen
Spiegelteleskope
Schulfernrohre
Aussichtsfernrohre
Kuppeln

Spektrographen
Passagegeräte
Planetarien

Punktal-, Uro-Punktal-
und Umbral-Brillengläser
Katalgläser
Zweistärkengläser
Haftgläser
Fernrohrbrillen
Lupenbrillen

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MICROSCOPES

FOR SCIENCE AND TECHNOLOGY



CZ 30-675a-2



300313/a



Bild 11. Covellin (Erzanschliff)
Hellfeld
Apochromat 15x/0,30 —
Homal II
Abb.-Maßstab 160:1



300337/a

Bild 12. Covellin (Erzanschliff)
Polarisation
(Polarisationsfilter +)
Apochromat 15x/0,30 —
Homal II
(Objektstelle wie in Bild 11)



300338/a

Bild 13. Lamellarer Perlit
(Grauguß)
Hellfeld
Apochromat 90x/1,30 H. I. —
Homal IV
Abb.-Maßstab 2000:1



Bild 14. Schnellstahl mit 18 %
W 10 % Co E 18 Co 10 über-
hitzt gehärtet
Planachromat 63x/0,65 —
K 6,3x/W
Abb.-Maßstab 500:1



300311/a

300315/a

Bild 15. Mikrohärteeindrücke
mit steigender Prüflast in
einem Kristall von Lagermetall
Apochromat 32x/0,65 —
Homal VI
Abb.-Maßstab 400:1

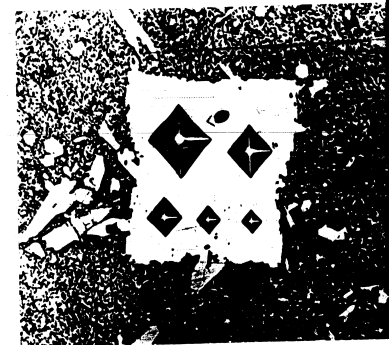


Bild 16. Mikrohärteeindrücke
mit gleichbleibender Prüflast
in Martensit (Kubischer Mar-
tensit — dunkel — in austeni-
tischer Grundmasse)
Apochromat 32x/0,65 —
Homal VI
Abb.-Maßstab 400:1



300335/a

0055 Y 3 2 A 2 4 0 9 0 0



Bild 6
Lamellarer
Perlit (Grauguß)
Hellfeld
Apochromat 60x/0,95 —
Homal VI
Abb.-Maßstab 630:1
(Originalgröße mit Kamera
13x18)

300344/a



300333/a

Bild 7. Elektrokorund
Tessar f = 135 mm
Abb.-Maßstab 1:1



Bild 8. Steinkohle (Relief-
anschliff)
Hellfeld
Mikrotar f = 90 mm
Abb.-Maßstab 8:1

300340/a



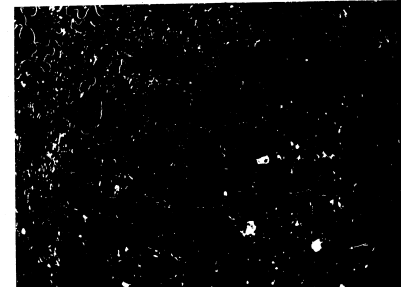
300336/a



Bild 9. Cordieritgneis
(Gesteinsanschliff)
Hellfeld
Triplet 5,5x/0,10 —
Okular Hm 4x
Abb.-Maßstab 32:1

Bild 10. Kupferoxydul
Dunkelfeld
Apochromat 32x/0,65 —
Homal VI
Abb.-Maßstab 500:1

300332/a



Das Ausmessen der Prüfeindrücke geschieht gewöhnlich mit einem stärkeren Objektiv und einem zentrierbaren Meßokular (Okular-Schraubenmikrometer), das mit Strichplatten versehen ist, die ein Planimetrieren der Eindrucksfiguren erlauben.

Die Anwendungsgebiete des Gerätes sind sehr mannigfaltig. Ob es sich um Vergleichshärtemessungen oder Reihenuntersuchungen, um Sprödigkeitsbestimmungen oder Orientierungsbeobachtungen an Kristallen handelt, immer kann der Mikrohärteprüfer mit Erfolg herangezogen werden. In einer Reihe von Fällen kann die Beobachtung der Mikrohärte auch entscheidend für die Diagnostizierung gleich aussehender Gefügebestandteile bei Gesteinen, Erzen usw. sein.

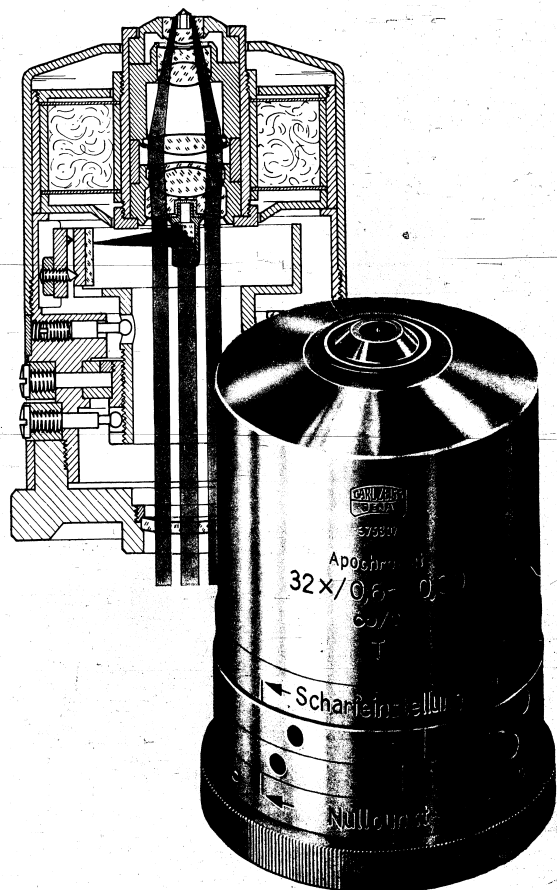


Bild 5. Mikrohärteprüfer Modell D 32

Während man bei der direkten Betrachtung des Mattscheibenbildes die Scharfeinstellung durch Fernbetätigung des Grob- oder Feintriebs erreichen kann, ist es auch möglich, das Mattscheibenbild mit Hilfe eines hinter der Kamera angebrachten schwenk- und drehbaren Spiegels vor dem Stativtubus sitzend zu beobachten. Mit dem Compoundverschluss sind Zeit- und Momentaufnahmen möglich. Eine seitlich angebrachte Orientierungsteilung erlaubt eine genaue Einstellung der Abbildungsmaßstäbe.

Die Platte des **Gerätetisches** wird von zwei Stützen getragen, die als Seitenschränken ausgeführt sind. In ihren Schubkästen sind die Zubehöriteile zum Neophot übersichtlich, sicher und staubgeschützt untergebracht. Wenig über dem Fußboden befindet sich zwischen beiden Seitenschränken eine Fußraste, die, besonders bei längerem Arbeiten, eine vorzeitige körperliche Ermüdung verhindert und deshalb als angenehm empfunden wird.

Die optische Ausrüstung des Neophot gliedert sich in drei Gruppen:

Die Ausrüstung für mikroskopische Beobachtung und mikrophotographische Aufnahmen im Bereich von 20:1 bis zu den stärksten in Betracht kommenden Maßstäben besteht aus Objektiven mit n. A. zwischen 0,1 und 1,3 und den dazugehörigen Kompensationsokularen. Besonderer Wert wird auf gute Bildfeldebnung gelegt. Soweit erforderlich, werden für die Aufnahmen an Stelle der Okulare besondere Projektionsysteme, Homale, angewendet, die das Bildfeld ebnen.

Nach wie vor halten wir an dem Prinzip fest, Objektive für Metallmikroskope auf die Tubuslänge ∞ zu korrigieren; es hat sich seit Jahrzehnten bestens bewährt. Die Objektive lassen sich durch einfaches Aufstecken auf den Illuminator schnell und bequem gegeneinander auswechseln.

Die optische Ausrüstung für Übersichtsaufnahmen im Bereich 4:1 bis 20:1 enthält mikrophotographische Objektive, die ohne Okular benutzt werden. Diese Systeme entsprechen in der Korrektur den Anastigmaten für die Photographie.

Für Makroaufnahmen im Bereich 0,5:1 bis 4:1 wird ein Tessar 1:4,5 f = 135 mm benutzt.

Als **Meßzubehör** sind in der Normalausrüstung ein einstellbares Okular K 7 X sowie je ein Objekt- und ein Okularmikrometer vorhanden.

Einige **Farbfilter** und **Mattscheiben** zur Erzeugung geeigneter Lichtarten sowie ein **Blendschutzglas** für die Beobachtung bei Bogenlichtbeleuchtung gehören ebenfalls zur vollständigen Ausrüstung.

MIKROHÄRTEPRÜFER MODELL D 32

Der von Prof. H. Hanemann gegebene Grundgedanke besteht in einer Vereinigung der zur Härteprüfung benutzten Vickers-Pyramide mit der Frontlinse des abbildenden Objektivs in der Weise, daß die Vickers-Pyramide axial in die Frontlinse des Objektivs eingekittet ist. Damit fällt das sonst notwendige und mit dem Fehler des mechanischen Spieles behaftete Auswechseln von Härteprüfer und Objektiv fort. Das Objektiv ist nicht fest mit dem Gehäuse verbunden, sondern hängt frei in zwei Scheibenringfedern, so daß es sich bei Belastung in der Richtung der optischen Achse bewegen kann. Die Größe dieser Bewegung ist ein Maß für die auf das Objekt wirkende Last und kann über ein optisches Hilfssystem an einer Skale beobachtet werden (Bild 5). Der Mikrohärteprüfer kann nur in Verbindung mit dem großen umgekehrten Auflicht-Kameramikroskop „Neophot“ bzw. mit dem kleinen Metallmikroskop „Epityp“ benutzt werden. Auf Grund seiner Bauart bietet der Mikrohärteprüfer Modell D 32 folgende Vorteile in der Handhabung:

Aufsuchen der gewünschten Objektstelle mit dem Mikrohärteprüfer selbst

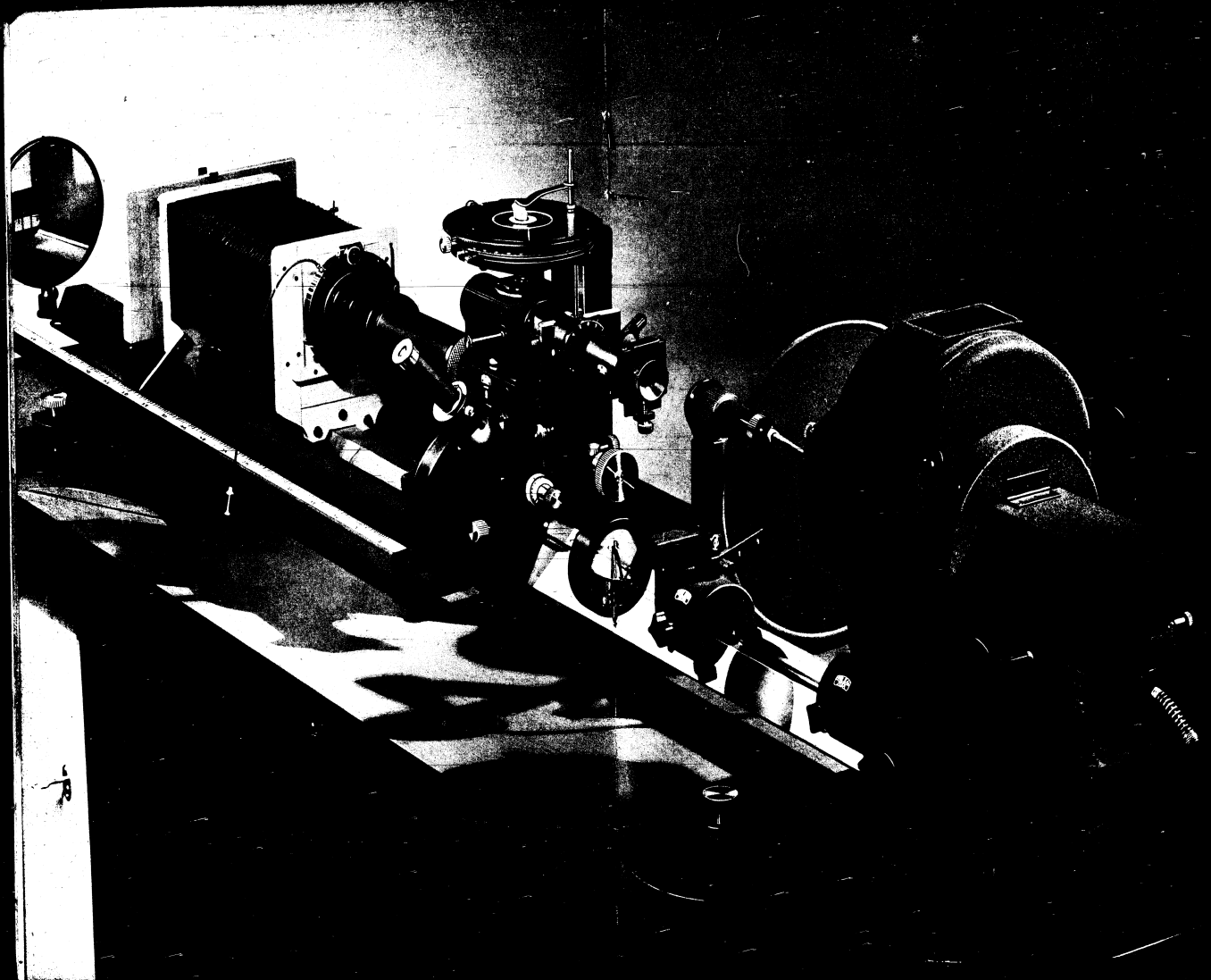
Erzeugen des Härteprüfeindrucks durch einfaches Betätigen des Mikroskoptriebs unter gleichzeitiger Kontrolle der Prüflast

unmittelbar folgendes Überprüfen des erzeugten Härteeindrucks nach Entlastung des Härteprüfers

außerordentlich hohe Treffsicherheit des Eindringkörpers bezüglich der ausgewählten Objektstelle

Möglichkeit der Prüfung sehr kleiner Gefügebestandteile bis herab zu etwa 0,01 mm Durchmesser

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Prismas mit denen bei Dunkelfeldbeleuchtung oder im polarisierten Licht so, daß sämtliche Übergänge von einer Beleuchtungsart in die andere schnell möglich sind, ohne daß die Stellung des Objektes oder die Scharfeinstellung geändert werden muß. Neben bequemster Handhabung ist dadurch eine leichte Vergleichbarkeit der verschiedenen Bilder gegeben.

Eine Leuchtfeldblende und eine Aperturblende mit seitlicher Verschiebung für schräge Beleuchtung ermöglichen es, die günstigsten Beleuchtungsverhältnisse auszunutzen.

Die Polarisations-einrichtung, die mit Polarisationsfolien ausgerüstet ist, besteht aus dem vor der Aperturblende einklappbaren Polarisator mit fest orientierter Schwingungsrichtung und dem am Illuminorkörper unten in Schlittführung aus- und einschiebbaren Analysator, der bei Skalenablesung von -5° bis $+95^\circ$ drehbar ist.

Das Dunkelfeld ist mühelos nach Betätigen eines Wechselschiebers und Aufsetzen eines Hohlspiegelkondensors bei entsprechender Beleuchtungsregulierung zu erhalten.

Als **Lichtquelle** zur subjektiven Beobachtung dient die kleine Mikroleuchte (6 V 15 W) an einem Schwenkarm auf Reiter. Für Dunkelfeldbeleuchtung und Mikrophotographie benutzt man das Licht der Bogenleuchte, der der Kollektor mit Kühlkuvette auf Reiter sowie (für Dunkelfeldbeleuchtung) eine Zusatzbeleuchtungslinse auf Schwenkarm vorgelagert sind. Störendes Seitenlicht wird durch einen großen Schirm abgehalten.

b) Für **Übersichtsaufnahmen** steht an Stelle des kombinierten Vertikal-illuminators für Hellfeld ein Aufsatz mit Planglas und Beleuchtungslinse, für Dunkelfeld ein Aufsatz mit Beleuchtungsspiegel und Mattglas zur Verfügung. Als Lichtquelle ist hier nur das Licht der Bogenleuchte anzuwenden.

c) Bei **makroskopischen Aufnahmen** wird das Objekt durch einen an einem Träger verstellbaren Spiegel beleuchtet, der sein Licht ebenfalls von der Bogenleuchte erhält. Spiegel mit Träger und Objektisch sind leicht in den Strahlengang ein- und ausschwenkbar.

Die weit ausziehbare **Kamera** (für die Formate 9×12 oder 13×18) wird bei Mikroaufnahmen durch einen Phototubus, bei Übersichtsaufnahmen durch eine Lichtschutzhülse lichtdicht mit dem Stativ verbunden. Außer der Matt- und der Klarglasscheibe mit Einstellupe hat die Kamera einen Multiplikator zur Durchführung von Belichtungsreihen und Stereoaufnahmen.

CARL ZEISS
JENA

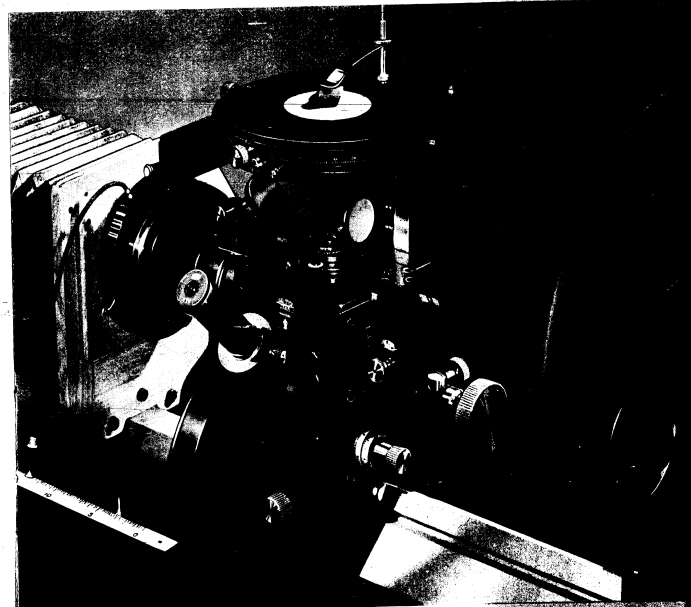


Bild 3. Einrichtung für Übersichtsaufnahmen im Dunkelfeld

Das Neophot ist für die Untersuchung aller Auflichtobjekte eingerichtet. Proben von kleinstem Ausmaß können mit solchen bis zu erheblichen Dimensionen und Gewichten variieren. Für die stufenlose Aufeinanderfolge der Abbildungsmaßstäbe im Bereich von 0,5:1 bis 1600:1 ist das Gerät mit drei verschiedenen Aufnahmeeinrichtungen ausgerüstet:

für Makroaufnahmen größerer Objekte mit einem Photoobjektiv im Bereich von 0,5:1 bis 4:1

für Übersichtsaufnahmen mit Mikrotoren im Hellfeld bei senkrechter Beleuchtung mit Planglas und im Dunkelfeld bei schräger Beleuchtung mit Spiegel im Bereich von 4:1 bis 20:1

für mikroskopische Beobachtungen und Aufnahmen im Hellfeld bei senkrechter oder schräger Beleuchtung, im polarisierten Licht und im Dunkelfeld mit Triplet und Apochromaten bzw. Planobjektiven im Bereich von 20:1 bis 1600:1

Ausrüstung des Gerätes

Zur Grundausrüstung des Gerätes gehören das Mikroskopstativ mit Objektisch, die Beleuchtungseinrichtungen und die Kamera. Alles zusammen ruht auf einer optischen Bank, die erschütterungsfrei in vier Schwingtöpfen gelagert ist. Die Schwingtöpfe selbst befinden sich in der Platte des zweckmäßig eingerichteten und form schönen Gerätetisches.

Das **Mikroskopstativ** trägt einen stabilen, zentrier- und drehbaren Kreuztisch. Zur Grobeinstellung wird er durch einen bequem zu handhabenden Grobtrieb bewegt, während die Feineinstellung durch Betätigen des Feintriebs auf den Vertikalilluminator wirkt.

Der Beobachtungstubus am Stativ vorn ermöglicht ein bequemes Arbeiten bei subjektiver Beobachtung. Sie ist monokular und binokular möglich. Für die letztere steht der binokulare Tubus „Bitumi“ zur Verfügung. Mit seiner Hilfe treten auch bei längerem Arbeiten am Neophot keine Ermüdungserscheinungen auf, da beide Augen gleichmäßig am Sehvorgang teilnehmen. Der Übergang zur Projektion auf die Mattscheibe geschieht sehr einfach durch Einrücken eines Stiftes neben dem Tubus.

Die Beleuchtungseinrichtungen

a) Der **kombinierte Vertikalilluminator** vereinigt die Untersuchungsmöglichkeiten bei Hellfeldbeleuchtung unter Anwendung eines Planglases oder eines



Bild 2. Einrichtung für Übersichtsaufnahmen im Hellfeld

DUPONT SAFETY 2000

005 Y 3 1 A 2 1 W 0 4 0 0

Neue Werkstoffe, neue Verarbeitungsmethoden und neuartige Endprodukte, sich ständig steigende Anforderungen an das Material verlangen ein optisches Prüfgerät von besonders hoher Leistungsfähigkeit.

Das aus jahrzehntelanger Erfahrung auf dem Gebiet der Metallmikroskopie hervorgegangene NEOPHOT wird der Forderung nach einem Universalgerät für Wissenschaft und Praxis in idealer Weise gerecht. Das Gerät verbindet vielseitige Anwendungsmöglichkeit mit einfacher und bequemer Bedienung sowie stabiler Bauart.

Für moderne Auflichtmikroskopie ist der Name ZEISS-NEOPHOT zu einem Begriff in der ganzen Welt geworden.

VEB CARL ZEISS JENA
Abteilung für Mikroskopie

CARL ZEISS
JENA

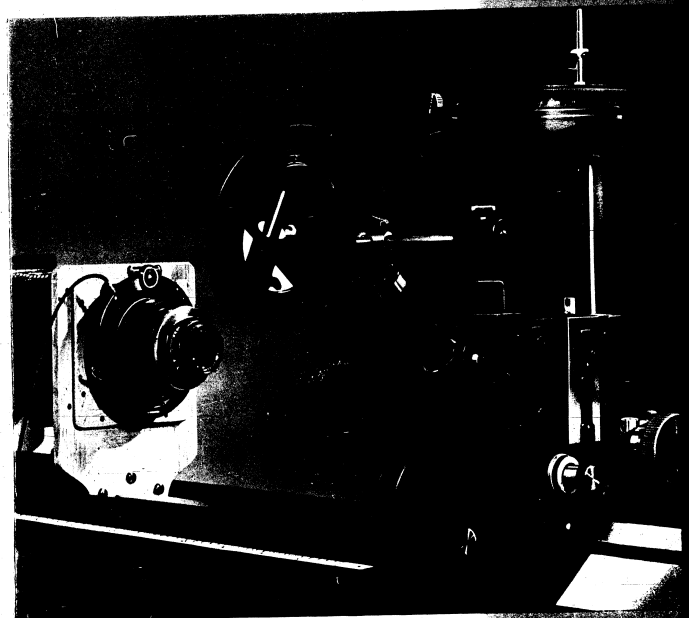


Bild 1. Einrichtung für Makroaufnahmen

Großes umgekehrtes Auflicht-Kameramikroskop

„NEOPHOT“

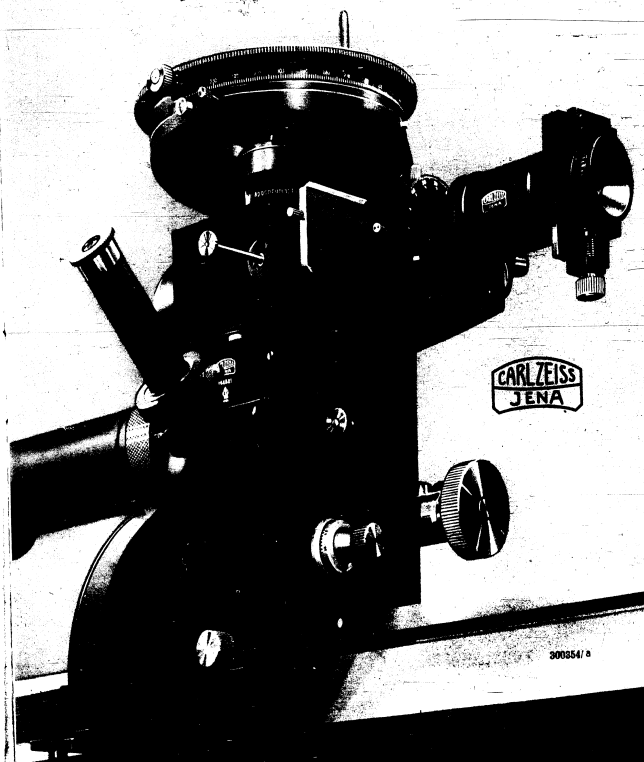
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Abteilung für Mikroskopie

Drahtwort: Zeisswerk Jena

Fernsprecher 3541



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spectacles
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Polarimeters
Pulfrich Photometers
Abbe Comparator
Monodromators
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and Alignments
Profile Projectors
Interference Comparator
Gauge Blocks
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Theodolites
Reducing Tacheometers
Supplementary Equipment
Mirror Stereoscope with
Tracing Stereometer
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Stereoplanigraph
Precision Coordinatograph
Rectifying Apparatus
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Opto-Physical Measuring Instruments Department

Telegrams: Zeisswerk Jena

Telephone 3541

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NEOPHOT



Literature

As far as possible we follow and collect the extensive and widely scattered literature. Thanks to the support of the authors, who regularly send us precise references and reprints of their publications, we are in a position to supply corresponding information. On the other hand, summarising presentations are found, among others, in

Berl-Lunge, 1931. Chemisch-technische Untersuchungsmethoden. 8th Edition I, p. 807—824 and Ergänzungswerk (1939), Part I, p. 366—391, Berlin (Springer).

Böhmer, A., Juckenack, A. and Tillmans, J., 1933. Handbuch der Lebensmittelchemie, II, p. 261, Berlin (Springer).

Kanthack, R.: Tables of Refractive Indices. Vol. I, Essential Oils, Vol. II, Oils, Fats and Waxes. London (Hilger).

Official and Tentative Methods of Analysis, 1935. 4th Edition, Washington, D. C. (Association of Official Agricultural Chemists).

Löwe, F., 1954. Optische Messungen des Chemikers und des Mediziners. 6th Edition. Dresden and Leipzig (Steinkopff).

Designation

Weight
los.Catalogue
No.

Codeword

Outline

1. for occasional measurements,
consisting of:

Abbe Refractometer Modell G, with interchangeable prism body, thermometer 0° to +75° C., adjusting plate, and a vial of monobromonaphthalene, in case

10.500

32 00 05

Ulgit

2. for serial investigations,
consisting of:

Abbe Refractometer Modell G, as under 1., with Universal Thermostat (Wobser-type) "U 3" for 220 V a. c. 48 to 52 cycles¹⁾, incl. contact thermometer — 30° to +110° C., with wire connection and 2 hose-connections

21.200

32.00 08

Ukurm

Outline and supplementary parts

Prism body, interchangeable

0.900

32 00 31

Ulgju

Thermometer 0° to 75° C., divided into 1° C., with protective sheath and screw connection

0.050

32 87 51

Udula

Special thermometer after Wollny (for butter and lard) with screw connection

0.050

32 87 52

Udsdu

Special thermometer after Baier (for summer and winter butter), with screw connection

0.050

32 87 53

Udsev

Correction thermometer (for milk fat determinations), with screw connection

0.050

32 87 54

Udsuk

Adjusting plate

0.005

32 05 00

Ulhud

Vial of monobromonaphthalene ($n_D^{20} = 1.65$)

0.040

32 09 00

Ueddi

Universal Thermostat (Wobser-type) "U 3" for 220 V a. c. 48 to 52 cycles¹⁾, incl. contact thermometer — 30° to +110° C., with wire connection and 2 hose-connections

10.700

32 87 06

Ulhve

Contact thermometer — 30° to +110° C. to Universal Thermostat

0.085

32 87 68

Ulhwt

¹⁾ Please request a special quotation for other voltage and kind of current.

as attack glass, kindly request further information. The prism body is interchangeable and it will be possible, therefore, to order spare prisms, without being compelled to return the instrument to the makers.

Further fields of application

Since years the Abbe Refractometer has frequently been used for purposes for which the butter refractometer and the milk fat refractometer were specially intended. Conversion tables have been made to facilitate converting the n_D values found with the Abbe Refractometer into the scale divisions of the butter resp. milk fat refractometer and vice versa. Upon request we include these tables with the Abbe Refractometer. Besides, the special thermometers according to Wollny and Baier provided for the butter refractometer resp. the correction thermometer for the milk fat refractometer, can also be supplied for the Abbe Refractometer.

Since years the refractometer for the sugar and oil industries has served for the refractometric determination of the dry substance in the various works juices of sugar factories. Aside from its external form, this refractometer differs from the Abbe Refractometer in that its measuring range is smaller; it lies between $n_D = 1.330$ and $n_D = 1.540$. However, many laboratories regularly use the Abbe Refractometer and only occasionally carry out dry substance determinations. With the new Abbe Refractometer, Model G, these determinations can be undertaken without the use of tables, for the percents dry substance from 0 to 85%, can be read off directly on a second scale placed on the glass circle to the right beside the refractive index scale.

Tempering arrangements

The refractive index of liquids varies with the temperature. To obtain comparable measurements and such of greatest possible accuracy it is necessary to carry out the measurements at a constant temperature. For this purpose a stream of water is conducted through the prism casings.

Note: The normal range of temperature for the employment of the refractometer covers from $+10^\circ$ to $+70^\circ$ C.

Please enquire with us where work at higher or lower temperatures is involved.

For occasional measurements it suffices to slowly circulate a stream of water through the prism casings from a reservoir holding about 20 l. The water is heated a few degrees above the normal temperature and slightly disinfected.

For continuous measurements the "U 3" Universal Thermostat (Wobser-type) (Fig. 4) is the appropriate apparatus for automatically furnishing a stream of tempering water. Temperature fluctuations of the heating liquid lie within about $\pm 0.02^\circ$ C.

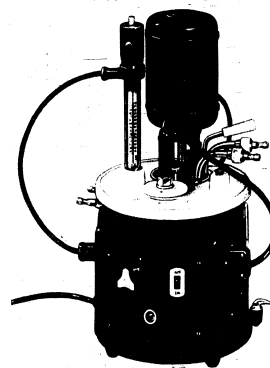


Fig. 4 (about $1/4$ nat. size). "U 3" Universal Thermostat (Wobser-type)

Detailed instructions for use accompany each Abbe Refractometer at time of delivery.

Prices for suitable outfits are given in price list 32-P110c-2.

To facilitate reading of the measuring results, the movable magnifier formerly employed has been replaced in the new construction by a reading microscope. The telescope for observing the border line of total reflection, and the microscope for reading the measuring value are firmly connected with one another and have an oblique direction of view, convenient for observation. The two oculars lie side by side and with some practise one can first set the border line on the intersection of the cross lines with the right eye, and then with the left eye at once read the measuring value. A translucent glass circle is used as carrier for the measuring graduation. Therefore the image in the reading microscope is distinguished by special clearness and good contrast, whereby the reading is facilitated and becomes more exact. The glass circle is mounted in a dust-tight housing and protected against damage, whereas the former scale, engraved on metal, was mounted exposed on the sector and subject to external influences.

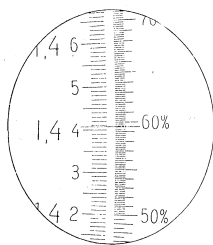


Fig. 2. View in the graduations in the reading microscope

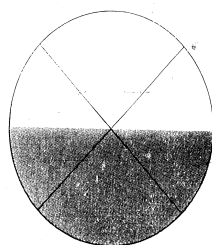


Fig. 3. The border line of total reflection set upon the intersection of the cross lines

The pinion head (4) for setting the border line is mounted so low that the hand can comfortably rest upon the table top while operating it.

The graduated circle carries 2 graduations, one with n_D values from 1.3 to 1.7, and the other dry substance values from 0 to 85%. The limit of error for

determination of the refractive index amounts to 1 to 2 units of the fourth decimal, and for the dry substance determination 0.1 to 0.2%.

Mode of operation

Light falling upon the mirror is reflected in the lower prism (illuminating prism), passes through the thin layer of the liquid to be examined and enters the upper prism (measuring prism). From here it passes into the telescope. This type of measurement is called measurement in transmitted light. If very darkly coloured samples, as for example molasses, marmelades, tar oil, etc. are to be measured, then at times measurement in transmitted light is no longer possible. Therefore recourse is had to measurement in reflected light, in that one allows the light to be reflected at the boundary surface of the measuring prism and sample. For this purpose one removes the round cover from the prism body (5). The light now falls directly into the measuring prism, is reflected at the surface wet by the sample and from there enters the telescope.

The measurement itself is based upon observation of the border line of total reflection. After charging the double prism with the sample to be investigated, one sees the field of view in the ocular of the telescope divided into a bright and a dark part. The separation line of the two fields is the border line of total reflection. With the use of daylight and incandescent lamplight, the border line for the first generally appears with a coloured margin. By operating the compensator this is made to disappear. By turning the pinion head (4) the now colourless border line is set upon the point of intersection of the cross lines. The reading in the microscope then furnishes for this setting the refractive index n_D or the dry substance content of the material examined. At the same time with the aid of a special table one can take the mean dispersion $n_F - n_C$ from the reading on the graduated drum of the compensator.

The prism casings of the refractometer are chromium plated. The instrument can therefore, observing suitable precautions, also be used for examination of weak acids. If strong acids are to be examined and also such substances

chemical and physicochemical institutes
 nutrition and dietetic institutes
 material testing establishments
 research laboratories
 technological and teaching institutions of higher learning
 hygienic laboratories
 physical institutes
 pharmacies
 chemicopharmaceutical industry
 foodstuff industry
 glass industry
 industry of ethereal oils and essences
 lacquer and colour factories

employ the refractometer for testing numerous substances for purity, for rapid determination of the concentration of solutions, as well as for measuring solid and plastic materials.

Some of the most important substances which are advantageously examined refractometrically are

edible fats, fish-liver oil, lubricating oils, soap, fatty acids, linseed oil, wood oil, varnish, oil of turpentine, petroleum, benzine, benzol, paraffins, ceresin, and other waxes;
 butter, margarine, cacao butter, lard, and other edible fats;
 aqueous, alcoholic, and ethereal solutions;
 optical glass, resins, synthetic materials, etc.

A detailed chapter "Refraktometrische Methoden in der technischen Chemie" is found in Löwe, F., 1954. Optische Messungen des Chemikers und des Mediziners. 6th Edition Dresden and Leipzig (Steinkopff).

- 1 focusing telescope for the border line
- 2 reading microscope for the measuring graduation
- 3 housing for the glass circle
- 4 pinion head for setting the border line
- 5 heatable and interchangeable prism body
- 6 compensator
- 7 pinion head for the compensator

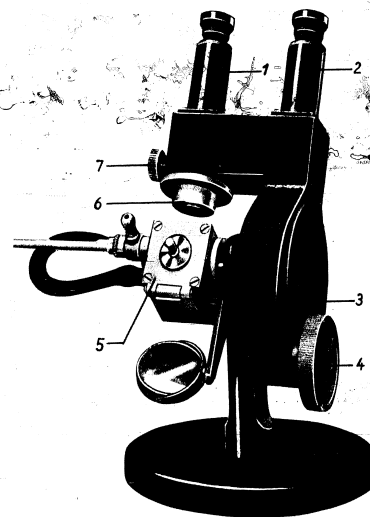


Fig. 1 (about 1/3 nat. size). Abbe Refractometer Model G

Description of the instrument

The refractometer consists essentially of the parts enumerated alongside the above illustration. The double prism in the heatable prism body (5) is composed of two equal flint glass prisms with refractive index $n_D \sim 1.75$, each cemented in a metal casing. The liquid to be examined is placed as a thin layer between the two facing surfaces of the prisms.

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In the year 1874 Professor Ernst Abbe, at the time Scientific Director of the youthful Jena works, offered to the public the refractometer which he had constructed. Today the method for determining the refractive index and the dispersion has become indispensable in chemistry. There hardly is a procedure which so rapidly and simply permits such an unequivocal characterisation of a substance as the refractometric.

Of all the refractometer models which have arisen in the subsequent years, the Abbe Refractometer has always retained the most universal range of measurement. n_D 1.3 to n_D 1.7.

Generally the Refractometer is used at measuring temperatures between $+10^\circ$ and $+50^\circ$ C.

The classical model of the Abbe Refractometer has undergone only minor structural changes during the last decades. Also in the new construction described in the following, the Abbe measuring principle has been retained. The construction however has been given a form which keeps pace with the current demands of technology. From this the following technical advantages result:

- interchangeable prism body with insulated lock knob,
- easier reading and therewith increased certainty of measurement,
- mounting of the measuring graduation dust-tight and protected against injury,
- ready location and therewith more convenient manipulation of the prism head for adjustment,
- measurements with higher or lower temperatures.

